ARMY RD&A

JANUARY–FEBRUARY 2000

Manufacturing Technology

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FROM THE ARMY ACQUISITION EXECUTIVE

A New Era In Manufacturing

Nobel laureate Madame Marie Curie once said, "One never notices what has been done; one can only see what remains to be done." I think she would agree that it is very important to stop and think about what we have accomplished so we can clearly focus on what needs to be done. Today, America's Army is the world's pre-eminent land warfighting force. We have a major role in military operations around the globe. Our military success is attributable to many factors, but especially to the contributions of our Nation's Defense industrial base. World-class weapon systems and equipment play a pivotal role in making the United States the world's unchallenged superpower. Today, what remains to be done is to enhance and extend our unquestioned military superiority within the battlespace to retain it in the future. The weapon systems we field during the next decade will be essential, and manufacturing plays a vital role.

Our military success led to changing circumstances—declining Defense budgets, consolidation of the Defense industry, increasing globalization of industry, and the increasing rate of technological change. All have significantly influenced Defense manufacturing. One of the most dramatic results was that the barriers between the commercial and Defense industries gave way to the benefits of commercial-military integration in both research and development and in manufacturing. Competition was the key.

Our Nation's warfighters are the major beneficiaries of this highly integrated environment. Competition increases efficiency and innovation so that soldiers receive better products, faster and cheaper. In the past, we demanded performance regardless of cost. Our savings came as a result of volume because cost was based on production rates. As our Defense budget declined and technology advanced, affordability became an important issue. How could we reduce quantity and cost without sacrificing performance and quality? The answer, of course, is through new manufacturing processes and the application of new technologies.

At the 1998 Defense Manufacturing Conference in New Orleans, LA, I visited the exhibit area to find out more about technologies and processes that can trim time and expense from every phase of the development cycle. I wanted to know more about breaking the link between cost and quantity. At the Boeing Phantom Works exhibit, I saw firsthand the benefits of laminated object manufacturing (LOM), a rapid prototyping technique for manufacturing 3-D objects based on 3-D geometrical data. The starting point is a sliced computer image of the object, which is used for controlling a laser beam that cuts the contours of foil materials. During the process, these foils are glued together and the physical object is created layer by layer. A variety of materials can be used, including paper, plastic, ceramic, or composite. The LOM process allows us to hold the created object in our hands, view it from different angles, and get an immediate and accurate representation. It is fast, affordable, and can show pending faults in the early stages of design before they cause problems later.

Another process to dramatically shorten the development phase and increase product quality is stereolithography. For more than a decade, leading manufacturers have used stereolithography to reduce prototyping and tooling lead times, and to build parts that are stronger, clearer, smoother, more durable, and provide a more accurate representation. These and other manufacturing techniques represent the power of virtual prototyping where what you see is what you get. Here, we are breaking the link between cost and quantity by dramatically reducing prototyping and tooling costs.

Several military-unique areas are especially important to Defense manufacturing technology. These include metals processing, electronics processing, and composites. For example, the C-17, procured by the Air Force and manufactured by Boeing, is critically important to the strategic responsiveness and deployability of the Army. Because the program is not new, cost reductions entail the selective redesign of major parts of the aircraft. Boeing used some of its best design and manufacturing techniques—3-D modeling and simulation, high-speed machining and automated production of large, single-piece composite skins—to redesign the all-metal tail and create a composite one. The new tail requires 90-percent fewer parts, 81-percent fewer fasteners, and 70-percent fewer tools to produce than the current tail. It costs only half as much and provides a 20-percent weight reduction as well. In essence, Boeing's success is our success.

In another important area, we used to design point solutions for specific platforms using military-unique components and architectures. We need to be more flexible and responsive in meeting the needs of the warfighter. To succeed in the future, we must use open architectures that allow horizontal technology integration across systems of systems. It is not simply that commercial information technologies are cheaper, although they can be. Nor is it always true that commercial solutions are more capable than the point solutions we have incorporated in the past. It often will be possible to design a military-unique solution that is more capable than anything presently available from the commercial market. The problem is that we take an average of 12 years to field a major system, while the power of the computer chips on which the commercial digital technology depends doubles every 18 months. The most important reason for us to gain access to commercial technology is not to save money; it is to get on the commercial innovation cycle using an open architecture. If we do this, we will gain the ability to modernize our weaponry through the timely insertion of communications and information technology—brain transplants.

Change is never easy. Perhaps the greatest hurdle to new ways of doing business is opening our minds to new possibilities. Fortunately, we live in an age of nearly limitless possibilities.

In closing, I wish you and yours a happy and healthy New Year!

Paul J. Hoeper

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FEATURES

DEPARTMENTS

ABOUT THE COVER

Manufacturing technology is a key element in the Army's vision to make its heavy forces lighter and its lighter forces more lethal. New processes, procedures, and materials at a reduced cost are part of the equation.

INTERVIEW WITH GEN JOHN G. COBURN, COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND

***Army RD&A*: How would you describe your leadership style?**

Coburn: I think my style is fairly simple. When I go out to our major subordinate commands and other activities, and even right here in our [AMC] headquarters, I tell people my number one priority is people, my number two priority is people, and my number three priority is people. So [there] you have it in three words—people, people, people. It's really important that we put the right people in the right place and empower them to do the job. Listening to people is critical. If you want to learn, you have to listen. I also emphasize that we must motivate and mentor our people. So all of us who have a leadership role, and that's a lot of us, must take care of [our] people. When you do that, creativity, productivity, and efficiency emerge. But first and foremost, start with people.

***Army RD&A*: What is AMC's role in fielding the First Digitized Division?**

Coburn: This effort is a major undertaking. It marks the initial fielding of the entire Army Battle Command System [ABCS], which links automation assets with communications media as well as operational facilities. What does all this do for the commander? It gives the commander a better opportunity to collect and analyze data—thus making monitoring tactical operations more effective, enhancing decision-making with real-time information, and enhancing the planning ability for future operations. AMC is providing significant support in several areas, such as testing, training, and of course, fielding the first digital force. The Communications-Electronics Command is an AMC subordinate command that serves as the Army systems engineer, and that's a critical role in this very important Army effort.

***Army RD&A*: The former Office of the Assistant Secretary of the Army for Research, Development and Acquisition has been renamed and has assumed operational control of logistic and mission functions previously assigned to the former Office of the Assistant Secretary of the Army for Installations, Logistics and Environment. How does this impact AMC?**

Coburn: This change doesn't really impact AMC's roles, mission, or organizational structure. In the past, the AMC staff worked closely with the [Department of the Army] DA staff and the Secretariat, and we continue to do so. I also believe this change at the Secretariat level will enhance communication between the logistic and acquisition communities at all levels within the Army.

***Army RD&A*: You have more than 35 years of Active commissioned service. What are the three biggest changes you have seen during your career in the way the Army conducts its acquisition business?**

Coburn: That's not an easy question to answer because I've witnessed many positive changes in how we do business. I would say that one of the areas that reflects tremendous change for certain

I believe the establishment of the Acquisition Corps has done a great deal to validate our commitment to develop a superb workforce.

is information technology. Almost every area of the Army has been affected by cutbacks—personnel, equipment, weapon systems, and even training. So the speed at which we access, process, and disseminate information is critical. AMC has led the way in moving Army acquisition into the paperless era. We have developed an Army single face to industry to provide industry a single entry point into all Army requirements. A centralized Web site lists all solicitations and attachments according to commodity, contracting office, the closing date, and the Standard Industry Classification code. That means that rather than paging through reams of *Commerce Business Daily* announcements, industry can quickly review all open solicitations in the Army. In the near future, industry will be able to respond with a proposal or bid to that same Web site.

A second area is the considerable change in the use of military specifications and military standards. During the past 4 years, the Army has achieved its goal to review, streamline, or eliminate more than 12,000 Defense standardization documents. This effort resulted in a 50-percent reduction in standardized documents being managed by the Army. So, we are seeing real change in how we do business and have essentially transformed the Army acquisition culture. One of the major benefits from this is that we're using performance-based requirements rather than prescriptive requirements, and that allows for more industry innovations. And of course, we're cutting costs in many cases because we use less expensive commercial items when it makes sense.

The third big change is related to just that—we've moved toward commercial practices within the Army. Today, we have more flexibility in how we conduct our acquisition business—so we streamline the process when we can. For example, we're currently able to procure up to $5 million in commercial items or services. This saves time, and in the long run, allows us to better serve our soldiers.

***Army RD&A*: How would you evaluate AMC's status regarding compliance with Y2K requirements?**

Coburn: Approximately 80 percent of everything that had to be fixed for Y2K in the Army was AMC's responsibility. We worked this issue since March 1996 and along the way, carefully took notes about our progress. We verified and validated our systems and spent 5 months testing, checking, and rechecking everything, as well as putting contingency plans in place in case we needed them.

***Army RD&A*: The Army Acquisition Corps was established a decade ago. What is the return on investment from this effort for AMC?**

Coburn: I believe the establishment of the Acquisition Corps has done a great deal to validate our commitment to develop a superb workforce. The investment is that we are building a team of people to meet the needs of our Army today and in the future. We now have both military and civilian professional development programs in a multitude of career specialties. This allows the workforce to achieve professional diversification—getting away from stovepiping. This allows us to broaden acquisition experience and knowledge. The return on investment is not necessarily measured in dollars, but rather by ensuring we are equipping and sustaining our Army the very best we can.

***Army RD&A*: Outsourcing is being used rather extensively throughout DOD. Given this, how do you plan to retain AMC's readiness capability?**

Coburn: Outsourcing is an important tool to help us streamline and modernize some of our efforts in AMC. Of course, we can't afford to view outsourcing as a cost-saving measure only, but always keep our focus on providing the best support to the warfighters. It's not necessarily an either-or situation, but rather a situation that must be looked at carefully, weighing the impact and assessing the pros and cons. I'm committed to ensuring that AMC continues to focus on supporting soldiers—and providing what they need, when they need it, where they need it. How we do that will continue to change, and outsourcing is one part of that change.

***Army RD&A*: How will initiatives like LOGMOD and Apache Prime Vendor affect AMC?**

Coburn: Initiatives like these represent how we are working hard to improve our processes and really taking a look at ways we can do better. The Wholesale Logistics Modernization [LOGMOD] Program will modernize the wholesale logistic processes and greatly enhance combat readiness. LOGMOD involves purchasing a service, not a system, to replace the antiquated 30-year-old system we rely on today. We will not be prepared for the future unless we transform how we supply and sustain our force. It's really that simple.

Prime Vendor Support is another initiative that optimizes industry's proven track record in sustaining the products it

develops. It's a pilot program with the potential to speed up the repair process and eliminate the layers between the manufacturer and the customer. Essentially, this program would give the wholesale logistics support of the Apache helicopter to a government-contractor team with the objective of reducing costs, improving availability of parts, and then reinvesting savings for reliability improvements and modernization of the weapons.

These initiatives require a lot of support from industry, Congress, and of course, DA and DOD. We're still working our way through the approval process, so they are still on the horizon.

***Army RD&A*: What are some of the key acquisition reform efforts you believe will most benefit the Army's procurement process?**

Coburn: We have a number of reform efforts that we're continuing to emphasize. The use of credit cards comes to mind immediately. I think the federal government started using them back in the mid-80s. Since that time, their use has expanded tremendously, saving time and reducing administrative procurement costs. Several years ago, the Federal Acquisition Streamlining Act set the micropurchase threshold at $2,500. It also cited the credit card as the preferred method of purchase for those micropurchases. Last year, the Army procured 97 percent of its micropurchases with the credit card, and in so doing, exceeded the DOD goal of 91 percent.

Partnering is another key effort that has really been successful. Of course, partnering requires commitment from both sides. Essentially, it is an informal process in which government and contractors work together. They build trust. They talk to each other along the way so they identify potential problems before they reach a conflict level. In AMC, we have more than 70 acquisition programs that are being partnered. We in AMC are really proud of our best value and trade-off source selection process. The process means evaluating industry solutions to Army requirements in areas like management practices, past performance, and costs, to determine which contractor will provide the best value to the taxpayer. We have a pamphlet about this that you can find on the AMC Web site. The title is *Contracting for Best Value*, and it's been adopted for Armywide use.

One effort we continue to pursue is a paperless environment that offers a faster and more efficient way for government and industry to do business. [The Office of the Secretary of Defense] OSD mandated that DOD become paperless by January 2000. There is no question that the Internet offers even greater potential for solutions in our acquisition business.

Long-term contracting is another important effort. It not only reduces paperwork and lead time, but it can also yield increased competition. Another benefit is the expectation that long-term sales could bring an expansion of the industrial base.

These are not necessarily new programs, but they represent a path of progress and significant change. We've made much headway in streamlining the acquisition process.

***Army RD&A*: There is currently a great deal of publicity about the revolution in military logistics. Can you describe what this is and how it will impact the Army in general and AMC in particular?**

Coburn: Logistics as we know it today must change, and it is changing. The revolution in military logistics parallels DOD's revolution in military affairs. Much of this revolution will be achieved through the use of advanced information systems that will allow for predictive logistics and delivery and give real-time in-transit visibility.

We've already talked about our antiquated software where we still rely on COBOL. The whole logistics modernization program initiative is one of the major steps we're taking to revolutionize our logistics business. Single stock fund is another major change in how we do our logistics business. It involves integrating wholesale and retail inventory management as well as the associated financial accounting functions. By merging the wholesale and retail stock funds, we will eliminate a level of management, decrease inventory levels, reduce manpower requirements, and very importantly, speed up the requisition process. The bottom line is that we are transforming Army logistics from a logistics mass concept to a distribution-based system, where just-in-time replaces the just-in-case system that meant large stockpiles, minimal or no in-transit visibility, and a less-than-rapid distribution system. It is important to note that we are striving to achieve logistical support, distribution, and redistribution that will cut across organizational and geographical boundaries of all Services. The revolution in military logistics challenges how we do business. We are already seeing innovation that challenges our old ways. It will help us harness the power of information technology—with the goal of equipping and sustaining the Army of the future even better. We have a long way to go, but I think we have a clear direction on how to get there.

***Army RD&A*: How would you rate the quality of personnel currently employed in the Army's acquisition and logistic communities, and what improvement in training do you suggest?**

Coburn: I firmly believe we have one of the finest workforces ever assembled. One of the things that makes it so is the synergy that we achieve by having a healthy mix of military personnel, civilians, and support contractors. I see a continuing need for proficiency training in both the acquisition and logistic fields. We must ensure that we work toward a close integration of these two endeavors.

INFRARED COOLED AND UNCOOLED STARING SENSOR MTO

Raemon N. Samuels and Neil D. Supola

Introduction

Infrared (IR) imaging systems have clearly demonstrated their value to U.S. military forces engaged in day and night warfighting operations. However, the effectiveness of these systems is largely dependent on the use of focal plane arrays (FPAs). As such, the Infrared Cooled and Uncooled Staring Sensor Manufacturing Technology Objective (MTO) is intended to develop and demonstrate manufacturing processes that allow for the production of affordable cooled and uncooled staring FPAs and associated components operating in the midwave infrared (MWIR) and long-wave infrared (LWIR) bands. This effort should dramatically reduce unit acquisition costs associated with the development of production-ready processes and increase commercial applications. Additionally, because of reduced system complexity and battery consumption, this technology will significantly reduce operations and support costs while providing the warfighter with smaller, lighter IR imaging systems with increased performance. Applications of this technology include driver vision enhancement systems, manportable weapon sights, remote surveillance systems, manportable mine detectors, missile seekers, future combat vehicles, and scout platforms.

Overall Program Structure

The MTO is structured as a two-phased research and development (R&D) effort managed by the Communications-Electronics Command (CECOM) Research, Development and Engineering Center Night Vision and Electronic Sensors Directorate (NVESD). Phase I, which is underway, will address uncooled FPA manufacturing technology while Phase II will cover cooled manufacturing processes.

Phase I of the MTO is part of a joint Dual-Use Science and Technology Program leveraging funds from the Defense Advanced Research Projects Agency (DARPA); the U.S. Army Manufacturing Technology (MANTECH) Office; Raytheon; Program Manager (PM), Night Vision/Reconnaissance, Surveillance and Target Acquisition; and PM, Javelin. The uncooled technology program addresses manufacturing issues associated with FPAs, optics, and electronics. Ultimately, the uncooled MTO will be directed at development of a manufacturing production line for producing both commercial and military FPAs. The final products will be used in systems such as small, manportable individual soldier weapon sights, low-cost Javelin missile seekers, emerging medium-performance sensors, and a variety of commercial applications. Figure 1 shows uncooled IR FPAs.

Phase II of this MTO will begin in the second quarter of FY00 and will address manufacturing issues associated with large-area, dual-color FPAs that will be used in the development of emerging high-performance weapon systems.

Overall Goal

The overall goal of this MTO is to develop and apply manufacturing processes, materials, tooling, and testing to support higher production yields and lower production costs. Table 1 on Page 6 shows some efforts to achieve this. This MTO will result in broadened availability of affordable and high-performance staring IR sensors. Designated as a 1999 Defense Technology Objective, this MTO has an expected cost avoidance-to-investment ratio of 22-to-1, with an expected cost avoidance of $415 million.

Uncooled Staring Sensors

This MTO has enabled a paradigm shift in uncooled staring sensors manufacturing. Instead of developing systems in the traditional military-use only role, the Army has developed the means to produce components for both military and commercial applications. Figure 2 illustrates how this paradigm shift provides low-cost military sensors by leveraging the volume and associated economies of scale provided by the commercial sector.

Low-Cost Uncooled FPA

The uncooled FPA MANTECH Program has experienced two major successes. First, this R&D effort has addressed manufacturing issues associated with decreasing the pixel size from 2-mil square detectors to 1-mil square detectors. This reduction in pixel area allows a corresponding reduction in system optics and housings, resulting in a total sensor

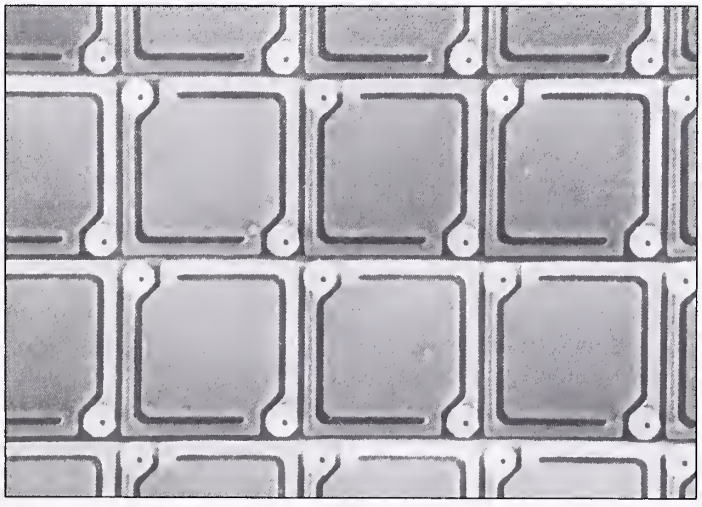

Figure 1. *Uncooled IR FPAs*

Table 1.
MTO Goals

Uncooled FPA and Systems	Cooled FPA and Dewar Assemblies
• Reduce cost while improving performance of ferroelectric monolithic IR detectors • Improve manufacturing process for small detector pixel size • Demonstrate the feasibility of using uncooled IR technology in a Javelin missile seeker. • Reduce cost while improving performance of 8 to 12 micron IR optics by addressing glass and polymer materials and processing • Optimize the ROIC and detector hybridization process • Transition manufacturing processes to the factory floor	• Increase detector wafer size and yield • Reduce cost by decreasing defect count and defect density • Increase ROIC yield • Optimize the ROIC and detector hybridization process • Reduce FPA test cycle time • Transition manufacturing processes to the factory floor

package that is significantly smaller, lighter, and less expensive.

Second, the military FPA technology has been transitioned from a unique military production line to a commercial production line at Raytheon. The military arrays are manufactured side-by-side with commercial arrays at a current production rate of 600 to 800 uncooled arrays per month. Future capacity will be approximately 1,200 per month. This insertion into the commercial production line increased the size of the FPA's silicon wafers for the integrated circuit from 4 to 6 inches. The larger silicon wafers resulted in an increased number of dies per wafer, which reduces manufacturing costs.

To integrate military requirements into commercial production lines, several processing steps were addressed. In the original process, the detector is manufactured separately and then attached to the Read-Out Integrated Circuit (ROIC). The new process fabricates the detector array directly onto the ROIC. This eliminates the need for separate fabrication of a ceramic detector wafer and the attachment process known as hybridization. As a result, there is a substantial decrease in touch labor (hybridization), which increases yield and reduces the net cost for FPA development. In addition, several other processes have been improved, including automated wire bonding, adhesive application, detector handling, and alignment.

The uncooled FPAs manufactured on the combined military-commercial production line will be integrated into military products such as the Javelin missile and into commercial products such as Raytheon's Microsight™ and Microcam™.

Low-Cost Optics

Although the dominant cost in IR imaging is associated with the detector and electronics, there are also substantial costs associated with the fabrication of the optical lens. When the current process development activities are completed, the time needed to produce an aspheric, diffractive IR glass lens from raw material will be reduced from more than 1 hour to less than 60 seconds. Similar improvements in IR polymer optical components are expected to allow replacement of much more expensive and heavier glass lenses, choppers, and windows found in current IR optical assemblies.

Thus far, IR optical assembly production costs have been reduced by more than half, and continuing developments promise much greater reductions, as high as 95 percent in some cases, compared to today's conventionally fabricated optical assemblies. This dramatic cost improvement is a key enabler for industry to successfully enter the commercial and low-cost military thermal-imaging markets.

Optical components produced by these revolutionary processes include glass and polymer lenses, polymer windows, and polymer choppers. The glass components are functional in the 3- to 5-micron and 7.5- to 13-micron wavelength regions, and the polymer components are optimized for the 7.5- to 13-micron wavelengths. These components will be suitable for cooled and uncooled, military and commercial thermal-imaging and industrial-radiometry systems.

Cooled Staring Sensors

The MTO will also address the production of cooled staring sensors in a 30-month effort that is currently scheduled to start in the second quarter of FY00. This program will concentrate on the production of two-color MWIR and LWIR staring FPAs. Sensor devices developed in this phase of the program will be 480 by 640 pixels or larger. In addition to two-color capability, these FPAs will provide increased sensitivity while decreasing power consumption and size. Operationally, the increased sensitivity will

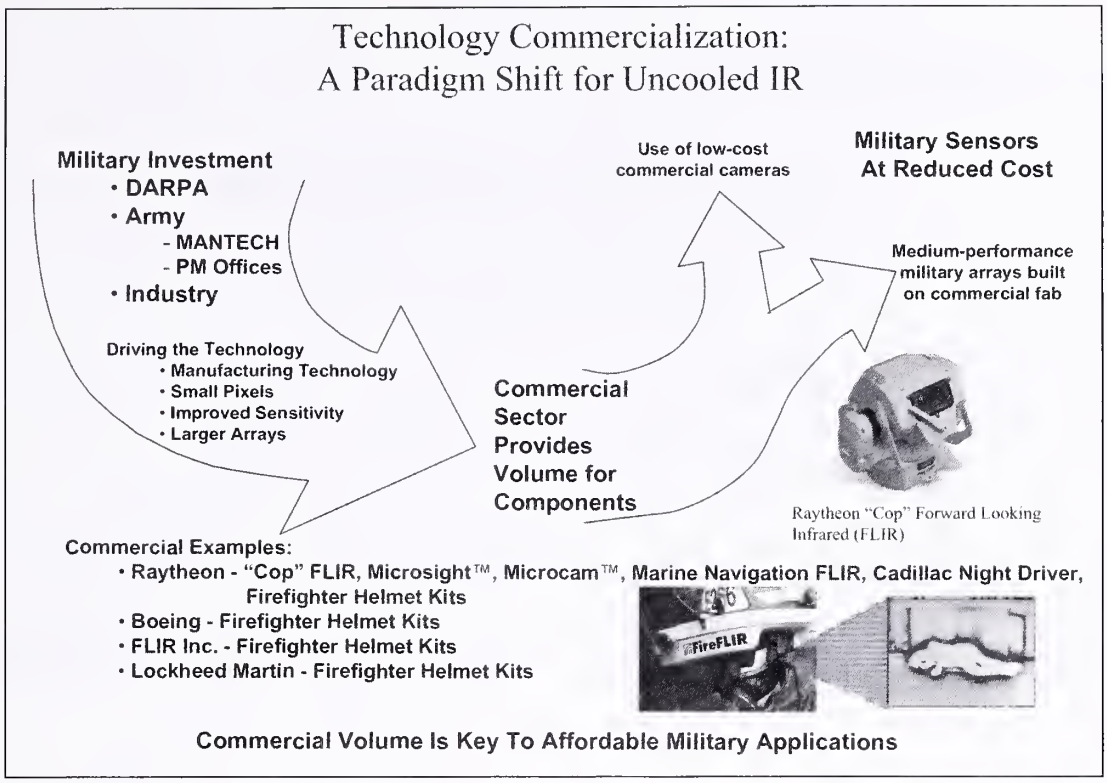

Figure 2.

result in improved range performance and improved capability to detect and identify targets. Weapon systems intended for long-range targeting and reconnaissance applications, such as the Future Combat Vehicle, Joint Strike Fighter, and future scout platforms, will benefit from these FPAs.

Conclusion

Traditionally, IR imaging systems have been heavy and expensive. This MTO is an integral piece of a MANTECH strategy that will produce smaller, lighter, and more affordable components for both military and commercial applications. This advanced technology program will play an important role in the development of a wide range of systems.

The uncooled phase of this MTO will have a significant impact on manportable systems such as individual weapon sights (Thermal Weapon Sight-TWS) and other high-quantity and lower performance systems such as the Driver's Vision Enhancer and the Javelin Seeker. Optical and FPA developments enable reductions in the weight, size, and power consumption critical to the user of manportable systems, while significantly reducing systems development costs resulting from large-quantity purchases.

In the near term, these same improvements will enable a new medium-performance class of uncooled sensors for military applications. Instead of trading system performance for smaller optics and electronics, lower weight FPAs allow integration of slightly larger optics, which deliver increased system range performance when compared to traditional IR sensor systems. Furthermore, by employing uncooled FPAs, the sensor systems avoid the power and reliability problems associated with cryogenic coolers found in cooled IR sensors. Finally, because these FPAs are built on a commercial production line, they are less costly because of high-volume commercial production, thus permitting their deployment into ground-vehicle platforms as replacements for used cooled sensors.

This two-phased MTO approach addresses the IR sensor needs of the entire Army. Even with the performance increases and cost benefits associated with the uncooled sensors, some users still require a cooled, high-performance FPA. These users can expect a significant reduction in the price of large-area two-color staring arrays, while obtaining increased sensitivity, decreased power consumption, and smaller packaged systems.

RAEMON N. SAMUELS is employed in the CECOM NVESD as the Project Leader for Second-Generation FPA Detectors and Dewars. He has worked extensively in the development of second-generation signal processing electronics, cryogenic coolers, and software; and first-generation detectors and dewars. Samuels holds a B.S.E.E. from Virginia Polytechnic Institute and is pursuing graduate studies in electronics and computer engineering at George Mason University.

NEIL D. SUPOLA is employed in the CECOM NVESD as the Team Leader for the Critical Components and Forward Looking Infrared (FLIR) Support Team. The team is involved in the operation of laboratory facilities used for testing (radiometric, imaging, and environmental) and development of detectors and dewars, cryogenic coolers, and optical assemblies. His background includes FLIR system development and laser counter-countermeasure testing and development. Supola has a B.S.Ch.E. from Virginia Polytechnic Institute.

An Army MANTECH MTO . . .

DEVELOPMENT OF PLASTIC ENCAPSULATED MICROCIRCUIT COATING PROCESSES FOR MILITARY APPLICATIONS

Peter P. Black and Donald E. Dunstone

Introduction

Former Secretary of Defense Dr. William Perry's memorandum of June 29, 1994, *Specifications & Standards-A New Way of Doing Business*, mandated DOD use of commercial off-the-shelf (COTS) technology wherever possible. This forced weapon system managers and system integrators in the Defense industry to expedite use of plastic encapsulated microcircuits (PEMs), leading to concerns over reliability, field performance, and life-cycle repair costs. COTS integrated circuits (ICs) are usually embedded in an epoxy material (plastic encapsulation) that provides environmental protection to the IC (but not hermetic protection) and mechanical support for the IC's electrical connections to the outside world.

The epoxy material is susceptible to water vapor intrusion, and any impurities within the epoxy material or on the IC can react with the interconnecting metal on the IC using moisture as a catalyst. This often results in corrosion of interconnected wires and bonding pads on the IC, leading to irregular performance and eventual device failure. Powering up PEMs helps to dissipate moisture through component heating, but some Army weapons such as missiles are stored for long periods without being operated (long-term dormant storage of 10 to 20 years or more). Unfortunately, little data exist to prove that commercially available PEMs will survive this environment. Compounding the problem is the fact that currently used military-grade hermetic parts are rapidly diminishing in availability as manufacturers close their unprofitable military specification markets because of decreased orders from the military (less than one percent of the total semiconductor market). This small market is the primary reason why commercial semiconductor manufacturers are reluctant to meet military requests for increased reliability. To make PEMs a viable replacement for military-grade ceramic-packaged devices, an inexpensive and effective protection scheme must be used to eliminate common failure mechanisms in PEMs. Concurrently, this scheme must add value to commercial applications in a way that encourages semiconductor manufacturers to adopt the protection method. The U.S. Army Aviation and Missile Command's (AMCOM's) Manufacturing Science and Technology Division, working with the Tactical Missile Program Executive Office, has initiated a Manufacturing Technology (MANTECH) Program to address these issues.

MTO

"Development of Plastic Encapsulated Microcircuit (PEM) Coating Processes for Military Applications" is a DA-approved Manufacturing Technology Objective (MTO) under the Army MANTECH Program. The goal of this effort is to demonstrate and develop a protective coating that can be economically applied, is accepted by the semiconductor industry, and provides the high level of environmental protection required by many military applications. The program leverages previous efforts funded by the Defense Advanced Research Projects Agency (DARPA) and the Air Force to develop a protective coating and processes that effectively seal the surface of ICs while still in the wafer form.

A recently completed Air Force Tech Base Program revealed that Dow Corning's ChipSeal™ can provide essentially hermetic protection to ICs that are exposed to highly accelerated stress testing (HAST). Figure 1 shows test data from that program indicating a high failure rate for standard PEMs, while the ChipSeal™-coated PEMs had a very low

failure rate, approaching that of hermetic controls. A microsection view of the ChipSeal™ coating is shown within the dashed line in Figure 2. The ChipSeal™ process uses a spun-on coating of flowable silicon dioxide (SiO_2) to planarize the wafer surface, followed by a topcoat of silicon carbide (SiC) to seal the wafer. Openings to the IC contact pads are then etched through the SiC and SiO_2. The contact pads are covered with a barrier metal of titanium tungsten (TiW) and then with gold (Au), sealing the etched openings and providing excellent electrical contact to the next level interconnect. All processes are accomplished using standard semiconductor manufacturing equipment.

A ChipSeal™ coating or similar approach offers a low-risk solution to the previously stated challenges for military system production. Benefits from such a protective coating include increased applicability of commercial ICs to harsh military environments, unit cost at or below the price of commercial ICs, and increased flexibility for military use of new and advanced semiconductor packaging. An economic analysis performed on six representative AMCOM systems shows a potential cost avoidance of more than $357 million for FYs 03 through 14 from the implementation of wafer-level protective coating technology.

AMCOM entered into a 36-month, competitively awarded, cost-shared, cooperative agreement with Lockheed Martin Missiles and Fire Control, Dallas, TX, on June 30, 1999, to execute the Army MANTECH PEM Coatings Program. The total amount of the agreement is more than $12 million, of which more than $7 million is contractor cost share. The vertically integrated Lockheed Martin-led team includes the following:

- Lockheed Martin and Boeing (military system integrators),
- TriQuint and Fairchild (semiconductor manufacturers),
- Dow Corning (material and process provider),
- Chip Supply Inc. (wafer brokering and packaging), and
- Johns Hopkins University (independent testing).

Program Plan

The major thrusts of this program are to select the best materials and processes for further development and cost reduction; collect reliability and cost data from the processing and testing of wafers coated with the protective material; demonstrate the improved processes on a semiconductor line; qualify selected components from participating weapon system project offices for implementation on their systems; and develop a business case to encourage semiconductor fabricators to incorporate the process and materials for most or all of their products. Planned activities are summarized below.

Material Evaluation And Selection. A literature search will determine if other materials and processes exist that can provide protective benefits similar to ChipSeal™. The material must provide hermetic-like moisture and corrosion protection, not negatively affect the operation of the IC, and be compatible with various semiconductor epitaxial materials and

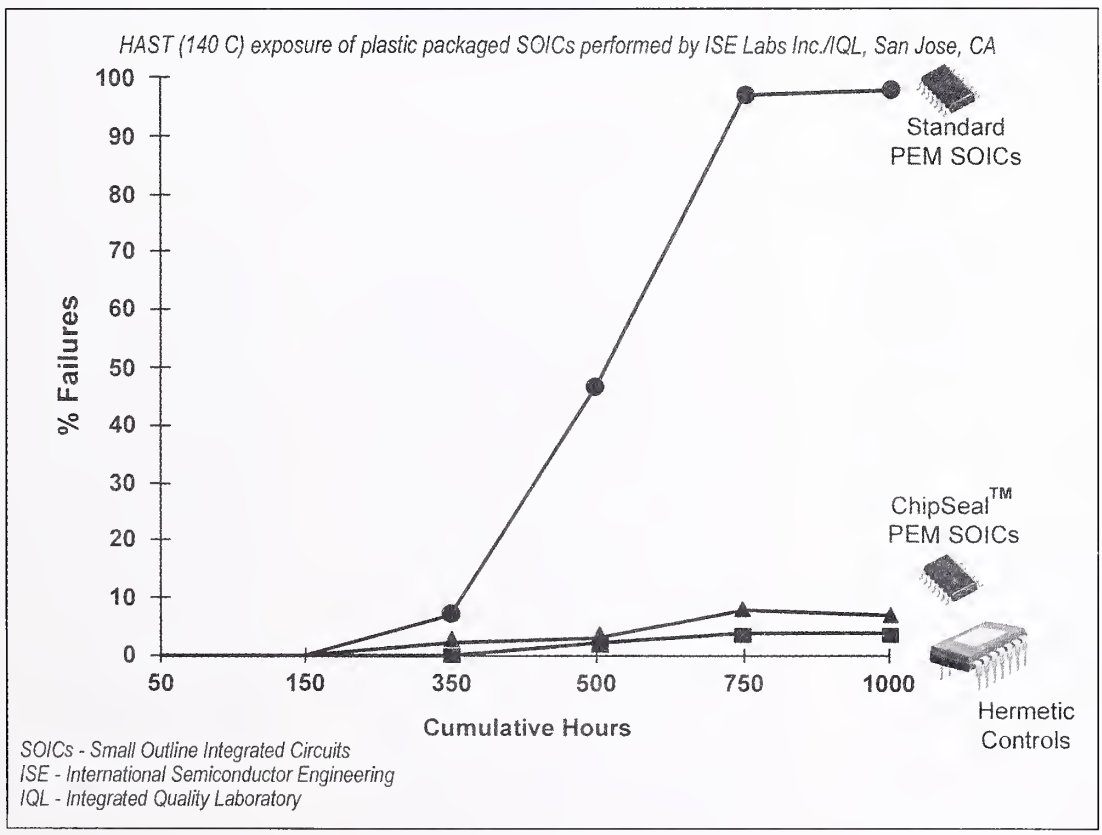

Figure 1.
ChipSeal™-coated PEM SOIC versus standard PEM SOIC reliability

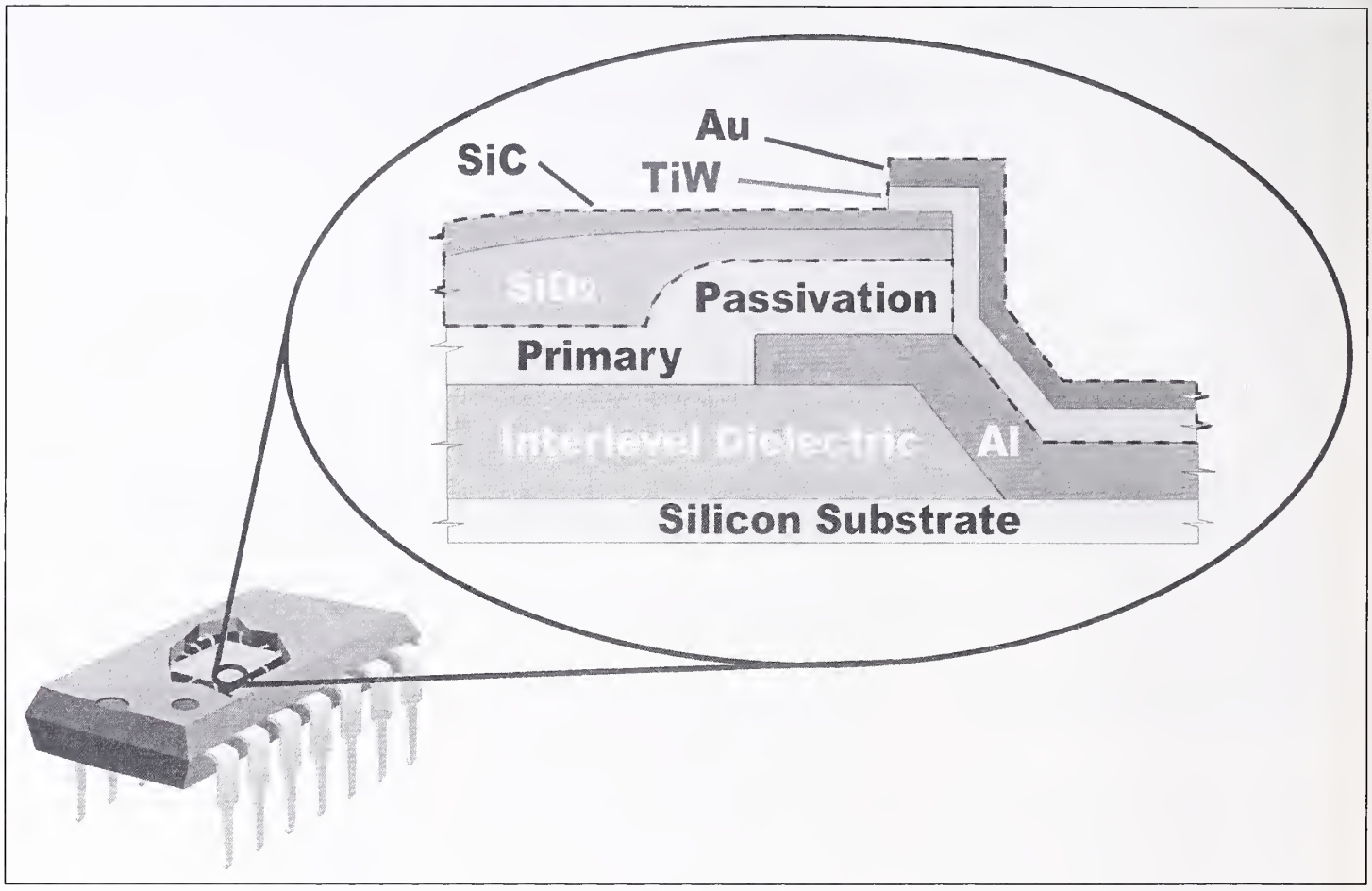

Figure 2.
Microsection view of IC with Dow Corning's ChipSeal™

manufacturing processes. The materials and processes must be inherently very low cost or be able to increase fabrication yields in the downstream packaging process. Both organic and inorganic materials will be studied. Materials and processes that meet the criteria will be selected for use in the remainder of the program.

Silicon And Gallium Arsenide Process Development. Selected coating material(s) and processes will be adapted for the silicon and gallium arsenide fabrication lines at the TriQuint and Fairchild facilities. Methods to lower processing cost and increase processing reliability (i.e., reduce steps, increase repeatability, simplify equipment requirements) will be developed and tested to validate effectiveness of the enhancements. In addition, a reliable under-bump metallization process for use on flip-chip and chip-scale package applications will be developed. The ChipSeal™ process currently produces an overcoat to the existing passivation layer on an IC. As part of the process development, experiments will be performed to determine if the standard passivation layer (usually silicon nitride) can be eliminated and replaced with the ChipSeal™ coating, reducing protective coating costs by as much as 50 percent.

Component Fabrication. A variety of ICs will be coated and packaged for independent reliability testing. Additional devices, specific to selected Army missiles, will be fabricated with protective coatings for use in hardware qualification tests. The devices will be manufactured at participating semiconductor fabricators' facilities or at a pilot facility, depending on feasibility. Testing will occur at several stages of fabrication, and processing information will be gathered to support analysis and modeling efforts.

Data Analysis And Modeling. Test data will be analyzed to determine the coating's impact on the performance and reliability of the ICs. Cost benefits of using the protective coating and its impact on packaging requirements will be studied. Increases in packaging yields will receive special attention because commercial fabricators are constantly struggling to improve yields. Data will also be used to validate the reliability benefits of the protective coating and provide specifics during the business case development. The contractor will also model the process flow as well as update current physics of failure IC models to account for the materials used in the protective coating. Models will be validated

through stress testing and then made available to the electronics design community to aid in future product design.

Independent Component Qualification. Several part types will undergo independent testing by Johns Hopkins University to validate contractor test data. A test plan will be developed by the program team and circulated among national test experts to obtain peer review and consensus.

Military Hardware Subsystem Qualification Testing. Components selected from at least two military systems will be fabricated with the protective coating and packaged as standard PEMs. A test plan similar to the qualification procedures will be developed and executed to demonstrate the reliability of the coated parts in military systems. Preliminary plans are to demonstrate the PEM coating capabilities on a redesigned missile guidance computer for the Army Tactical Missile System and in power supplies used on the Comanche helicopter. Further DOD weapon system demonstrations and implementations are being developed, and more will be solicited during the course of this program.

Business Case And Implementation Plan Development. One very important aspect of this program is to develop the scenarios and reasoning to encourage commercial adoption of this IC protection method. Anticipated benefits of commercial interest are very low implementation and processing costs, little or no impact on the processing line, and yield increases at all fabrication levels. The business case and implementation plan will include significant involvement of the participating commercial semiconductor fabricators, TriQuint and Fairchild. Early adoption of the coating methods will give them an initial advantage over the rest of the industry and serve as a model for further implementations. The implementation plan also calls for development of a strategy to rapidly encourage adoption in the semiconductor industry. A roadmap for weapon system implementation will also be developed.

Government And Industry Workshops And Demonstrations. Semiannual government and industry workshops are planned to publicize the ongoing status of the program, solicit feedback, and encourage collaborative efforts toward implementation of the PEM coating techniques. The first workshop is planned for February 2000. An industry demonstration is planned at the end of the program to demonstrate the material(s) and processes in place at a semiconductor fabricator's facility.

The use of low-cost PEMs will potentially reduce screening and qualification requirements and reduce life-cycle costs through reduced repair costs and longer life spares.

Conclusion

The PEM Coating MTO will allow Army weapon system program managers and Defense system integrators to use low-cost PEMs for a much broader range of applications than previously permitted. The use of low-cost PEMs will potentially reduce screening and qualification requirements and reduce life-cycle costs through reduced repair costs and longer life spares. By protecting the IC at the wafer level, the military can take advantage of smaller, lighter, and higher performance commercial electronic packaging such as flip-chip and chip-scale packages that were previously unsuitable in nonhermetic form. It is inevitable that commercial parts will be increasingly incorporated into DOD systems. The PEM Coating MTO will ensure that COTS chips can be inserted with greater confidence of their reliability in military applications, allowing DOD to keep pace with rapidly advancing commercial technology well into the next millennium.

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FUTURE SCOUT AND CAVALRY SYSTEM ADVANCED TECHNOLOGY DEMONSTRATION

John A. Torvinen and MAJ(P) James M. Parker

Introduction

In October 1996, the U.S. Army and the British army signed a Statement of Intent to explore the possibility of establishing a cooperative program to develop a new manned ground reconnaissance vehicle. The vehicle will replace the U.S. Bradley Cavalry Fighting Vehicle and the High Mobility Multipurpose Wheeled Vehicle in scout and cavalry units and the United Kingdom (UK) Combat Vehicle Tracked-Reconnaissance. The U.S. Future Scout and Cavalry System (FSCS)/UK Tactical Reconnaissance Armoured Combat Equipment Requirement (TRACER) will be a new, C130-deployable reconnaissance system incorporating affordable and mature advanced technologies.

Program Beginning

Combat developers in the United States and the United Kingdom discovered through their existing Armor Combat Developer Exchange Program that both armies had a similar need for a new reconnaissance vehicle. Based on this need, the U.S. Armor Center's Directorate of Force Development received the Joint Requirements Oversight Council's approval in April 1997 of a mission needs statement for a new ground reconnaissance capability.

After signing the Statement of Intent, both nations began negotiating a Memorandum of Understanding (MOU) that would contain several key agreements governing program structure and execution. First, a Joint Project Office (JPO) was established with the United Kingdom as the lead. Second, it was agreed that the United Kingdom would be the contracting authority that would issue the Invitation to Tender (ITT) (similar to a U.S. Request for Proposal) while the United States would lead the Source Selection Evaluation Board (SSEB). Third, it was agreed that both nations would equally split development costs.

The U.S. Army's formulation of an acquisition strategy culminated in November 1997 with the approval of the FSCS Advanced Technology Demonstration (ATD) Plan and its designation as the first Fast Track Program. Fast Track is a new Army acquisition reform initiative to accelerate the development and fielding of advanced technologies.

The key to Fast Track is the selection of a technology that has a high probability of successfully transitioning from a science and technology (S&T)-funded ATD to a program executive officer-managed program in engineering manufacturing and development (EMD). Advancing directly from an ATD to EMD eliminates the normal concept exploration (CE) and program definition and risk reduction (PDRR) phases. Fast Track requires that a technology demonstrate its maturity by meeting selected exit criteria at the end of the ATD.

In the case of FSCS/TRACER, the program must demonstrate that its technologies are sufficiently mature and that they can be successfully integrated into a reconnaissance system. FSCS/TRACER will draw its technologies from Army S&T and development programs, U.S./UK contractor research and development, and UK technology and development programs. The elimination of the CE and PDRR phases saves FSCS/TRACER an estimated 4 years in development time over a traditional acquisition program. It also closely aligns with the traditional UK acquisition process. The program schedule calls for a 42-month ATD, followed by a 56-month EMD phase, and then production.

The FSCS/TRACER Program requires both S&T expertise and program documentation for a combined Milestone I/II decision before entering into EMD. To accomplish these objectives, the FSCS Program Office employs a hybrid of engineers with S&T expertise from the Tank Automotive Research, Development and Engineering Center (TARDEC) and specialists with program management experience from the Program Executive Office, Ground Combat and Support Systems (PEO, GCSS). The FSCS Program Office at TARDEC in Warren, MI, is led by Roland Asoklis, a board-selected project manager. The TRACER Program Office at Abbey Wood, Bristol, UK, is led by COL Peter Flach.

During negotiation of the MOU and development of the acquisition strategy, the U.S. and UK combat developers spent many hours together creating a draft Operational Requirements Document (ORD). The draft ORD has more than 95 percent of its requirements common to both nations. As the draft ORD evolved, U.S. and UK engineers began meeting to translate the requirements into performance specifications that would form the draft Technical Requirements Specification (TRS). These meetings also provided forums for sharing technologies between the two nations. This technology transfer evolved from general exchanges to an established process between governments and, finally, to contractors. A large quantity of U.S. and UK technical and program information was made available to contractors.

While these government activities occurred, industry in the United States and the United Kingdom began to form competitive teams. The Lancer Team (hereafter referred to as Lancer) formed under GEC-Marconi as the prime contractor with Raytheon, United Defense Limited Partnership, and Alvis as the major subcontractors. Sika International (hereafter referred to as Sika) was created as a joint venture between British Aerospace and Lockheed Martin, with General Dynamics Land Systems and Vickers Defence Systems in another joint venture as the major subcontractors. The FSCS and TRACER Project Offices issued versions of both the draft ORD and TRS to Lancer and Sika for their review and comments.

Program Status

On July 7, 1998, the United Kingdom signed the MOU (previously signed by the United States) and shortly thereafter

released the ITT to Lancer and Sika. As part of an Alpha contracting initiative to decrease the time before contract award, a small team from the FSCS Program Office traveled to the United Kingdom in mid-August to coordinate a review of Lancer and Sika's draft proposals. The FSCS Team and their UK TRACER Team counterparts spent a week at each contractor team's headquarters. While the small FSCS Team was in the United Kingdom, the remaining FSCS Program Office personnel, working with their UK counterparts, conducted a detailed trans-Atlantic review of the Lancer and Sika proposals. Lancer and Sika received the results of the reviews for incorporation into their final proposals. Besides helping Lancer and Sika prepare quality final proposals, Alpha contracting also provided time for a dry run of the SSEB. The discussions between U.S. and UK counterparts during this period made the later harmonized evaluation of the formal proposals easier and faster.

By Jan. 29, 1999, the source-selection activities had concluded and the contracts were signed by the United Kingdom. The JPO then created an integrated process and product development (IPPD) structure to enable the separate national program offices to work closely together and to integrate easily into the Lancer and Sika IPPD structures. Soon after contract award, there were meetings in the United Kingdom for IPPD training with Lancer and Sika as well as start-up of integrated product team (IPT) meetings for Lancer and Sika. To maintain an equal work share in the JPO and equal exposure with Lancer and Sika, the JPO split the IPT leads for each between the program offices. For example, the FSCS Program Office has the JPO lead for coordinating with Lancer on survivability, while the TRACER Program Office has the JPO lead for coordinating with Sika on survivability. Both JPO leads work closely together to ensure that each knows what the other is doing and that Lancer and Sika are treated equally.

Modeling and simulation (M&S) is important in both the JPO's and Lancer and Sika's efforts to integrate the many new technologies into the FSCS. Virtual prototyping is a critical tool that Lancer and Sika will use to help them design and develop their concepts. To recognize the importance of M&S to the program, FSCS has been designated as one of the Army's four Simulation and Modeling for Acquisition, Requirements, and Training (SMART) flagship programs.

The FSCS/TRACER Program also includes a combined U.S./UK government analysis. Guided by the Combined Analysis Plan, the U.S. and UK technical and operational analysis communities are merging their skills to produce a combined analysis of the FSCS/TRACER Program that both nations can use. This combined analysis requires the sharing of closely held M&S information between the governments and with Lancer and Sika.

Program Future

The first products of the analysis will feed into a Three-Star Affordability Review of the program in January 2001. Based on the results of the initial analysis, the affordability review will provide guidance on the unit cost and refined requirements of the FSCS/TRACER. Cost as an independent variable will be helpful in the affordability review and will assist the JPO in developing affordable requirements and performance specifications for EMD. At the end of the ATD phase, the United States and the United Kingdom will select one team to continue into EMD and production.

Following contract award, Lancer and Sika began analyzing the draft requirements and performance specifications. In addition, each conducted intensive operational and technical analyses to determine the affordability and performance of the potential subsystems they will use in their concept design processes. By the affordability review, Lancer and Sika must deliver to the JPO three costed concepts: a $3-million-unit-production cost concept, a concept that at a minimum meets all of the draft threshold performance specifications, and a concept that optimizes a mix of cost and performance. The JPO will combine the government analysis work with information and decisions from the affordability review to adjust and finalize the ORD and TRS in preparation for release of the EMD ITT to Lancer and Sika and a Milestone I/II decision.

Concurrent with the affordability review, the FSCS Program Office will complete its transition from TARDEC to PEO, GCSS. PEO, GCSS will manage the program for the rest of the ATD and beyond.

Six months before the end of the ATD, Lancer and Sika will deliver integrated demonstrator assets for JPO evaluation. The integrated demonstrators are important risk-reduction tools through which Lancer and Sika will demonstrate the maturity of their technologies and their ability to successfully integrate those technologies. The demonstrators will undergo technical testing with a limited operational evaluation to assist in tactics, techniques, and procedures development.

Conclusion

The dedicated, all-weather, ground reconnaissance capability provided by the FSCS/TRACER will significantly contribute to providing situation awareness and understanding to future tactical commanders at the battalion, brigade, division, and corps levels. The vehicle's command, control, communications, computers, and intelligence (C41) system will manipulate and transfer the required level of data, over the distance required, to the appropriate level of command. The C41 system with a suitable digitized architecture will provide secure, jam-resistant, voice, data, and imagery transmission over multiple nets. The FSCS/TRACER design will incorporate signature management, thermal imagery, radar, acoustic sensors, and automatic target acquisition and aided target identification.

The technologies and digital capabilities of the FSCS/TRACER will provide tactical commanders the ability to view the tactical situation clearly and maneuver their forces with the speed and effectiveness needed for the 21st century nonlinear battlefield. Studies have shown that the FSCS/TRACER will far surpass existing Scout systems. By leveraging technology, FSCS/TRACER will dramatically lower supportability costs while improving the Army's ground reconnaissance capability. The FSCS/TRACER is the one system that will fulfill a critical mission need for two armies.

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THE ARMY TECHNOLOGY AND MATERIEL GAME

Roy H. Cooper and Bruce M. Fonoroff

Introduction

The Army vision to make heavy forces more agile and light forces more lethal and survivable is being aggressively pursued through a number of key initiatives of the Army Science and Technology (S&T) Program. One of these key initiatives is the Army Technology and Materiel Game (TMG), which provides critical insights into how the Army can best target its S&T strategy to achieve the Army's vision.

The 1999 TMG, sponsored jointly by the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology and the U.S. Army Training and Doctrine Command (TRADOC), consisted of the following activities: TRADOC development of user needs to support forces of the 2020 era; S&T community development of S&T investment summaries linked to user needs; two technology workshops to identify critical technologies to enable the user needs; and a business strategy game used to develop alternative S&T strategies to achieve the user needs. A more detailed description of the 1999 TMG follows.

The TMG Process

The TMG was designed to solicit a critical "outside" examination of the link between the Army S&T Program and future Army needs. The TMG also provided the means to identify alternative S&T investment strategies that may allow the Army to better achieve these future needs or possibly achieve them sooner. The TMG process included three sequential activities. First, based on ongoing analysis and observations from the TRADOC AAN (the Army After Next) Spring War Game, TRADOC developed ambitious user needs to support the force of the 2020 era. Next, descriptions of critical technologies necessary to enable these user needs were refined via two technology workshops held in May and June 1999. Finally, potential alternative S&T investment strategies to achieve these needs were developed at a business strategy game held at the Army War College, Carlisle Barracks, PA, in July 1999. The critical components of the TMG process are illustrated in the accompanying figure.

Development Of User Needs

Early in the TMG process, TRADOC defined a notional year 2020-era hybrid force that included both revolutionary warfighting systems and modernized legacy systems. This force was evaluated in the TRADOC AAN Spring War Game, and insights from this evaluation were used by TRADOC to define 23 broad user needs. For purposes of discussion in the workshops, these ambitious futuristic needs were organized, prioritized, and categorized by TRADOC into three broad technology focus groups: lethality/survivability/mobility (LSM); combat service support (CSS); and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR).

Technology Workshops

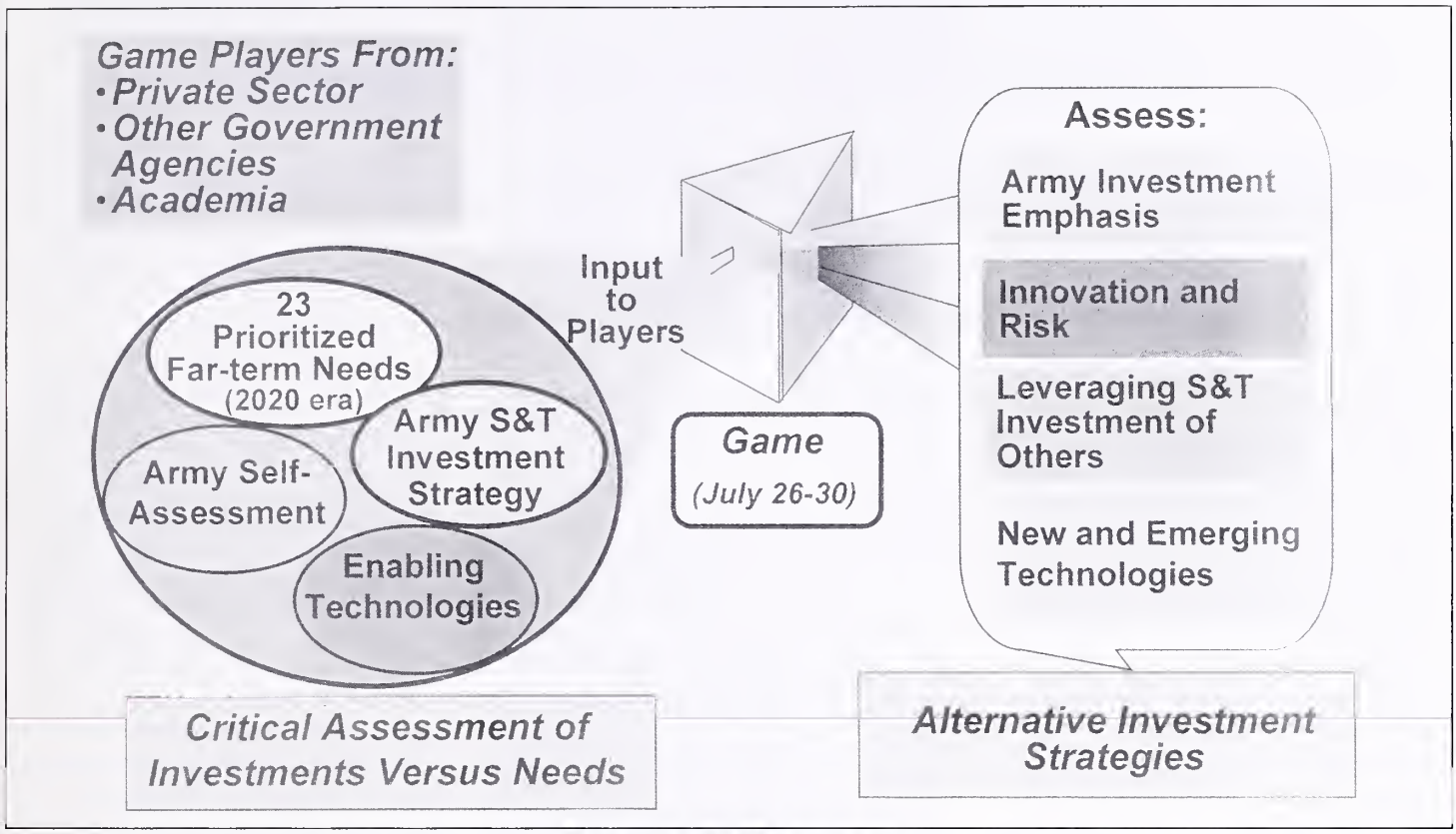
Two technology workshops were conducted before the actual TMG business game. The purpose of both workshops was to allow outside experts to identify the breadth of critical technologies that may enable future user needs. In the first workshop, members of the Board on Army Science and Technology (BAST) identified several broad families of critical technologies. The second workshop, sponsored by the Association of the United States Army, drew more than 75 participants from other government agencies and the private sector. They identified and characterized more than 100 critical technologies.

The Business Strategy Game

The 1999 TMG concluded with a business strategy game in which groups of players competed for resources needed to satisfy user needs. The game was conducted by the Army Materiel Command (AMC) with support from Booz•Allen & Hamilton. Business gaming is a method frequently used by the private sector to examine new business assumptions in the presence of diverse stakeholders and to develop alternative strategies for investing limited resources. Because of the striking similarities between the commercial sector and the Army planning environment, a business game rather than a traditional war game appeared to be an effective approach.

Primary player input was in the form of a unique management summary of the Army S&T investment strategy linking current investments in Applied Research and Advanced Technology Development Programs (budget areas 6.2 and 6.3, respectively) to each of the 23 prioritized user needs. Using this summary, the Army S&T community assessed the likelihood that these S&T Programs would mature critical technologies sufficiently to support decisions to proceed into system development activities by FY11, or by FY03 if efforts could be accelerated. Both the S&T management summary and the TMG players emphasized the broad areas of LSM, CSS, and C4ISR in three technology focus groups.

Players used this information to assess the Army's level of innovation and risk taking, the adequacy of leveraging the S&T investment of others, incorporation of new and emerging technologies, and appropriateness of S&T investment emphasis. Through a series of sequential game moves, players were



Summary of TMG process

challenged to react to three different funding scenarios. In each case, the objective was to enhance the likelihood that critical technologies would be matured sufficiently to support decisions to proceed with system development.

The first of the three funding scenarios was a zero-sum alternative in which Army S&T funds could be "reprogrammed" among existing S&T investments. The second allowed an incremental increase of 15 percent to the total S&T budget. The third allowed the application of unconstrained resources. The corresponding strategies developed by the three technology focus groups were assessed by a select group of players called the Integration/Adjudication Team.

In addition to the examination of the 6.2 and 6.3 programs, the business game assessed the role of the Army's Basic Research Program (budget area 6.1) in meeting future user needs.

Sixty-three senior managers from 43 organizations, including industry, academia, other Services, and government agencies, played the business strategy game. Industry was represented by 24 companies including those that traditionally supply the Army as well as nontraditional suppliers such as DuPont Agricultural Products, Caterpillar, Smith Kline Beecham, and Federal Express. Other participants included the Department of Energy (DOE) and the National Reconnaissance Office.

TMG Results

Results of the three alternative investment strategies led players to conclude that significant additional funding and reprogramming are required for the S&T Program to effectively meet the near-, mid-, and far-term user needs. Players attributed these conclusions to the traditionally risk-averse nature of Army investments, the ambitious statement of user needs, a basic research program that appeared too focused on the near term, and not enough exploitation of the S&T investments from others outside DOD.

Each of the technology focus groups approached the resource allocation scenarios differently. The CSS group reprogrammed resources from lower priority long-term needs to higher priority efforts. The LSM group reduced support for uncertain payoff, higher risk programs in favor of lower risk programs. The C4ISR group reduced funding for mature technologies in favor of less mature and unavailable technologies supporting high-priority user needs.

During the TMG, players identified 156 technologies that they thought enabled solutions to user needs. Subsequent analysis showed the Army to be investing in about 130 of these through existing Science and Technology Objectives.

Relative to leveraging the S&T investment of others, the players provided an interesting paradigm for assessing the Army investment strategy:

- Adopt: Use the technology developed by others,
- Adapt: Modify the technology developed by others, and
- Develop: Army leads the development.

Players cautioned that leverage is not free, and that the Army must invest in tracking and monitoring the S&T investments of others.

Potential Implications For The Army S&T Program

The TMG provided a significant number of valuable observations. Aggressive actions are underway to refine the S&T investment strategy in response to these observations. For example, TMG players thought the Army's Basic Research Program, while well leveraged, was too conservative and too focused on the near term; i.e., needs-driven rather than opportunity-driven. To better direct the Basic Research Program, the Army will increase the percentage of its support for longer term strategic research objectives (SROs) from 24 percent today to between 40 and 50 percent by FY03. In addition, all SROs will be reviewed annually. Increasing the fraction of the basic research support directed at SROs will allow management to shift the program toward longer term focused research.

On the basis of game insights, the Army has begun to shift its strategy toward investments in "best-value" technology—those technologies that address the highest priority user needs and can be matured at the lowest cost. Based on this observation, current budget activities have increased investment in high user priority lethality and survivability and sustainment needs through specific enhancements to advance materials, active protection, robotics, and ultrareliability technologies.

Continued exploitation of TMG insights regarding best value and enhanced leveraging of outside investments will require additional information about specific families of critical enabling technologies. During FY00, independent review teams (IRTs) will perform a series of assessments on a number of broad technology areas. Comprised of independent experts from industry, government, and academia, IRTs will assess the Army's S&T investment strategy and provide specific recommendations regarding the following:

On the basis of game insights, the Army has begun to shift its strategy toward investments in "best-value" technology—those technologies that address the highest priority user needs and can be matured at the lowest cost.

- High-payoff, innovative technologies the Army should track or consider for investment;
- Opportunities to tap into the S&T investments of others; and
- Appropriate funding emphasis for the Army in targeted technology areas.

On the basis of this information, the Army S&T Program will continue to be focused on current and future investments in best-value technologies.

Conclusion

The TMG is an effective method to critically examine a portion of Army investment that will have a large impact on achieving the Army vision. This vision is supported through initiatives across a broad mix of enabling technologies with investments in the Army's Basic Research, Applied Research, and Advanced Technology Development Programs. To ensure continued success, the S&T investment strategy must be carefully crafted and continuously refined to better leverage the S&T investments of the private sector, other government agencies, and foreign countries; ensure sufficient emphasis on specific technologies to achieve their timely application; and focus on technologies whose benefits in terms of payoff and availability are justified by the high risk of achieving these benefits.

The 1999 TMG provided valuable insights that are changing current S&T investment strategies and will change future strategies. At least 1 year is probably required before the full impact of these changes can be measured. The Army is considering another business strategy game in 2001 to assess the insights from the 1999 game and to provide new insights for subsequent refinement of future S&T Programs.

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AFFORDABLE COMPOSITE STRUCTURES: A MANUFACTURING TECHNOLOGY OBJECTIVE

Walter Roy

Introduction

The Army's vision for the future is to make its heavy forces lighter and its lighter forces more lethal. Composite manufacturing technology is being called on to achieve the first part of this goal. Polymer matrix composites are significantly lighter than metals and are being considered for ever-increasing roles in Army weapon systems. Composites have long been a staple in the DOD aircraft business, however, composite components have been costly to produce. Consequently, one of the overall goals of the manufacturing technology objective (MTO) is to decrease the cost of composite components 25 percent.

The first weapon system platforms to be addressed are the Comanche, Apache, and Crusader. The Comanche currently has a predominantly composite (70 percent) airframe structure. There are, however, opportunities to reduce cost and extend the use of composites to other components such as fittings and shafts.

Conversely, the Apache currently has a metallic airframe. As part of the Rotary Wing Structures Technology Demonstration (RWSTD), a prototype Apache composite midfuselage will be fabricated with the primary objective of reducing weight.

For the Crusader and its resupply vehicle, composite turret prototypes are being constructed. Initial prototypes were significantly more expensive than production targets. Several tasks are being initiated through the MTO that will help meet production cost targets. In the munitions area, an effort is underway to develop an inexpensive composite 120mm mortar fin to replace the current aluminum one. This will provide a 25-percent cost savings and improved performance.

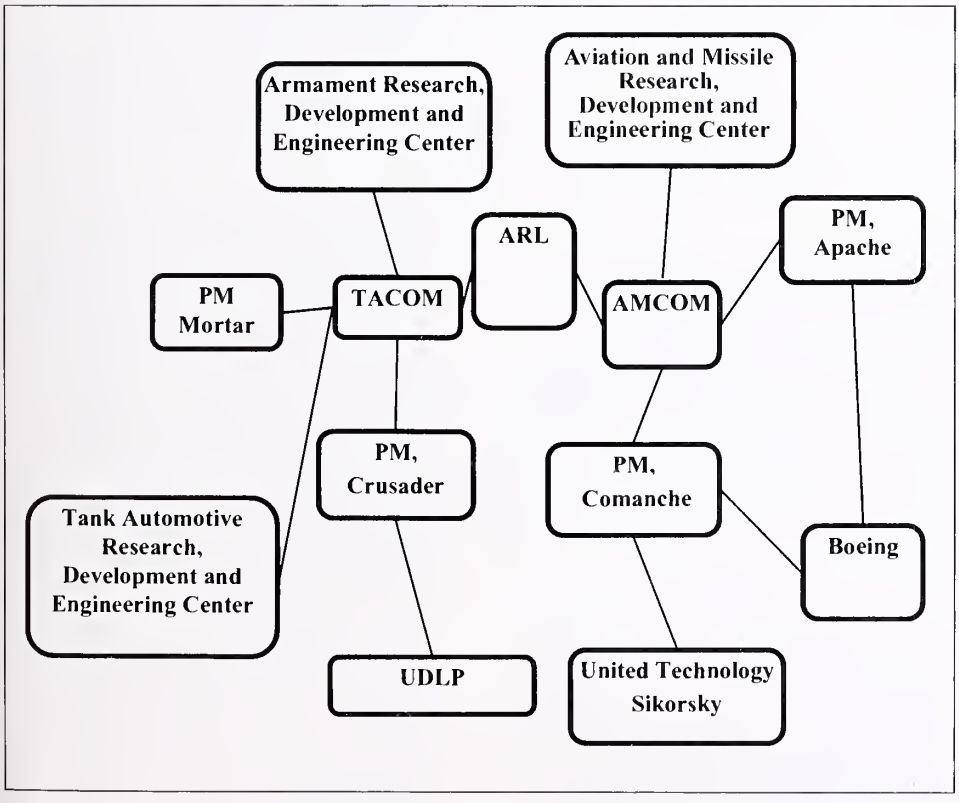

Figure 1.
Program participants

Management Approach

The Army Research Laboratory (ARL), the Tank-automotive and Armaments Command (TACOM), and the Aviation and Missile Command (AMCOM) are teamed to execute the Composite Manufacturing Technology Program. The key to the successful transition of any technology is the involvement of the prime contractors. In this program, the prime contractors of each major weapon system are involved: Boeing for Apache and Comanche (tail section), Sikorsky for Comanche, and United Defense Limited Partnership (UDLP) for the Crusader. Figure 1 shows the primary program participants. In addition to these participants, a number of subcontractors and the Center for Composites Manufacturing at the University of Delaware are involved.

A number of partnerships have been established to leverage MTO resources (approximately $3 million annually plus cost sharing from the prime contractors) with other Army and DOD composite technology efforts. The most significant of these partnerships is with the Composites Affordability Initiative (CAI), which is a Defense Technology Objective (DTO) funded by the Navy and Air Force to support the Joint Strike Fighter. Even though the technologies of the CAI are directed

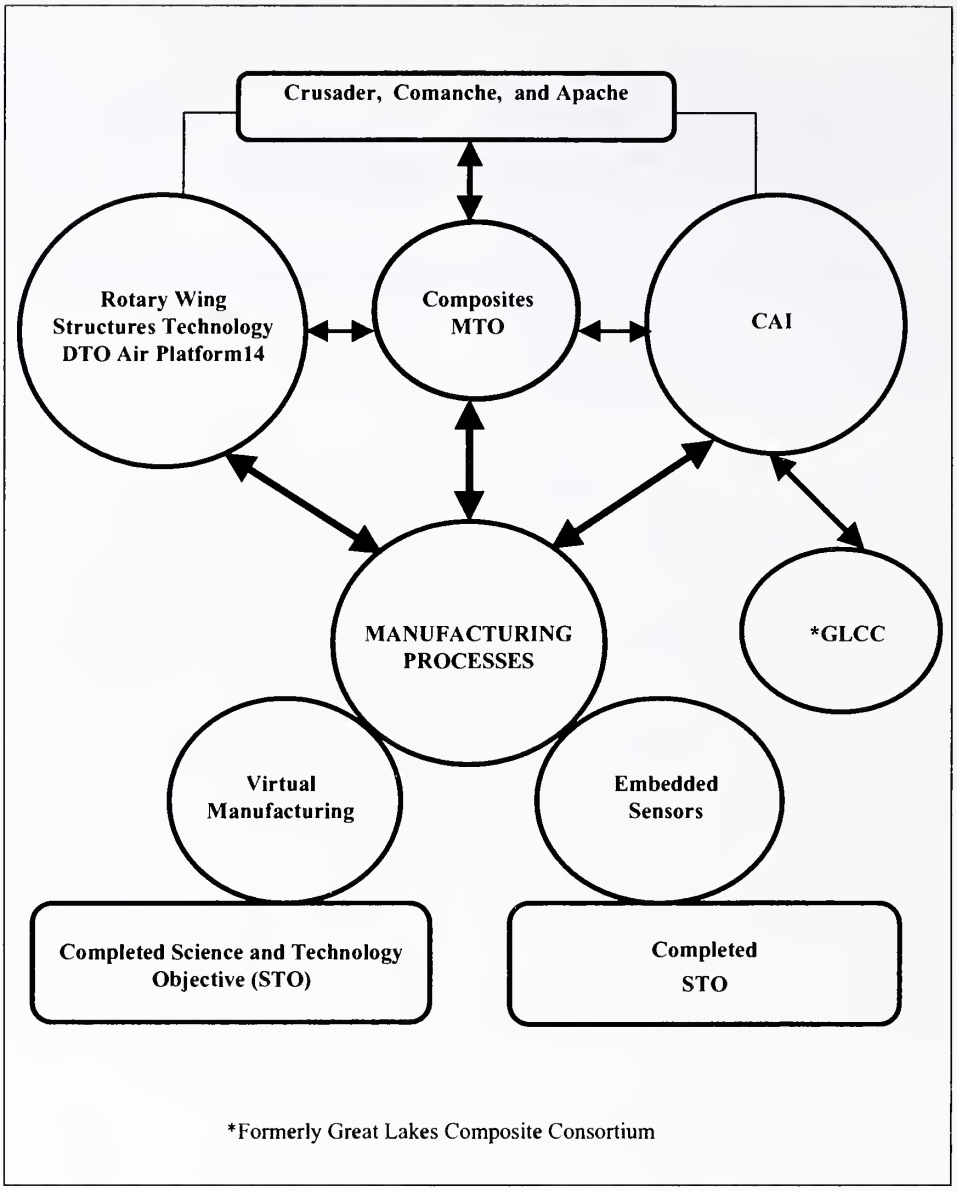

Figure 2.
MTO linkages

toward fighter aircraft, there are many generic technologies applicable to Army needs. Within the Army, other efforts such as the RWSTD are being leveraged to increase effectiveness of MTO resources. Figure 2 shows the leveraging and cross-linking arrangements.

Program Goals

As stated earlier, the major objectives of the Composite Manufacturing Technology Program are weight savings and cost avoidance. All three of the major systems being addressed by the MTO have weight-saving requirements that will result in reduced logistic requirements (such as to-theater transportation and in-theater fuel requirements) and will improve performance (such as range or survivability). An example is the composite turret on the Crusader, which is 15 percent lighter than the standard metallic baseline, without a threat to the crew. Even though the Comanche is now 70 percent composites, the Army expects to reduce the weight another 15 percent. The MTO will help enable the 15-percent weight reduction in the lower forward fuselage with an additional goal of 25-percent reduction in labor hours.

Cost-benefit goals are significant. Cost avoidance with the Comanche is projected to be several hundred million dollars throughout production of the fleet. In addition, logistical benefits from reduced weight can be even more impressive for heavy vehicles such as the Crusader. Crusader weight reductions enabled by composite components can save several hundred million dollars in fuel costs. Even a 25-percent cost savings for a relatively inexpensive fin for the 120mm mortar ($4 for a $16 fin) can result in a large cost avoidance when procurement quantities are in the hundreds of thousands.

Technologies

This MTO is primarily a technology maturation and transition program. There are a number of technologies addressed throughout the program, including a generic baseline of common technologies applicable to all of the systems. Examples of these technologies are modeling, electron beam (e-beam) curing, sensor-based process control, improved vacuum-assisted resin transfer molding (VARTM), improved quality assessment, and cost modeling. More system-specific technologies include automated preform fabrication and lay-up for Crusader, improved thermoplastic processing using inductive curing, paintless finish for helicopters, lean tooling, primary adhesive bonding, and self-locating assembly. Figure 3 shows common technologies and specific applications.

During the first year of the MTO, one of the most significant developments was the improvement and application of a resin flow model for the VARTM process commonly used for many weapon system applications. Prior work was performed to develop a model for the resin transfer molding process. This model was enhanced to simulate the VARTM process.

The obvious advantage of modeling is risk reduction. Components can be resin-filled in a virtual environment to identify potential problem areas that will be difficult to completely fill with resin, thus creating lean or dry spots. The accepted practice is to base the design of the component, mold, and injection location on past experience and then use trial and error to perfect the process. This is a very expensive way to produce quality parts. With an accurate model, the fill-out of a virtual component can be accomplished and potential problem areas identified in minutes. On subsequent virtual runs, process parameters such as the location of injection ports can be changed and the resultant resin flow evaluated.

The improved model has been applied to virtual components for both the Apache and Comanche helicopters and combine favorably with actual results from risk-reduction prototypes. Model improvements will continue to be made to make it more user friendly and improve its computational speed.

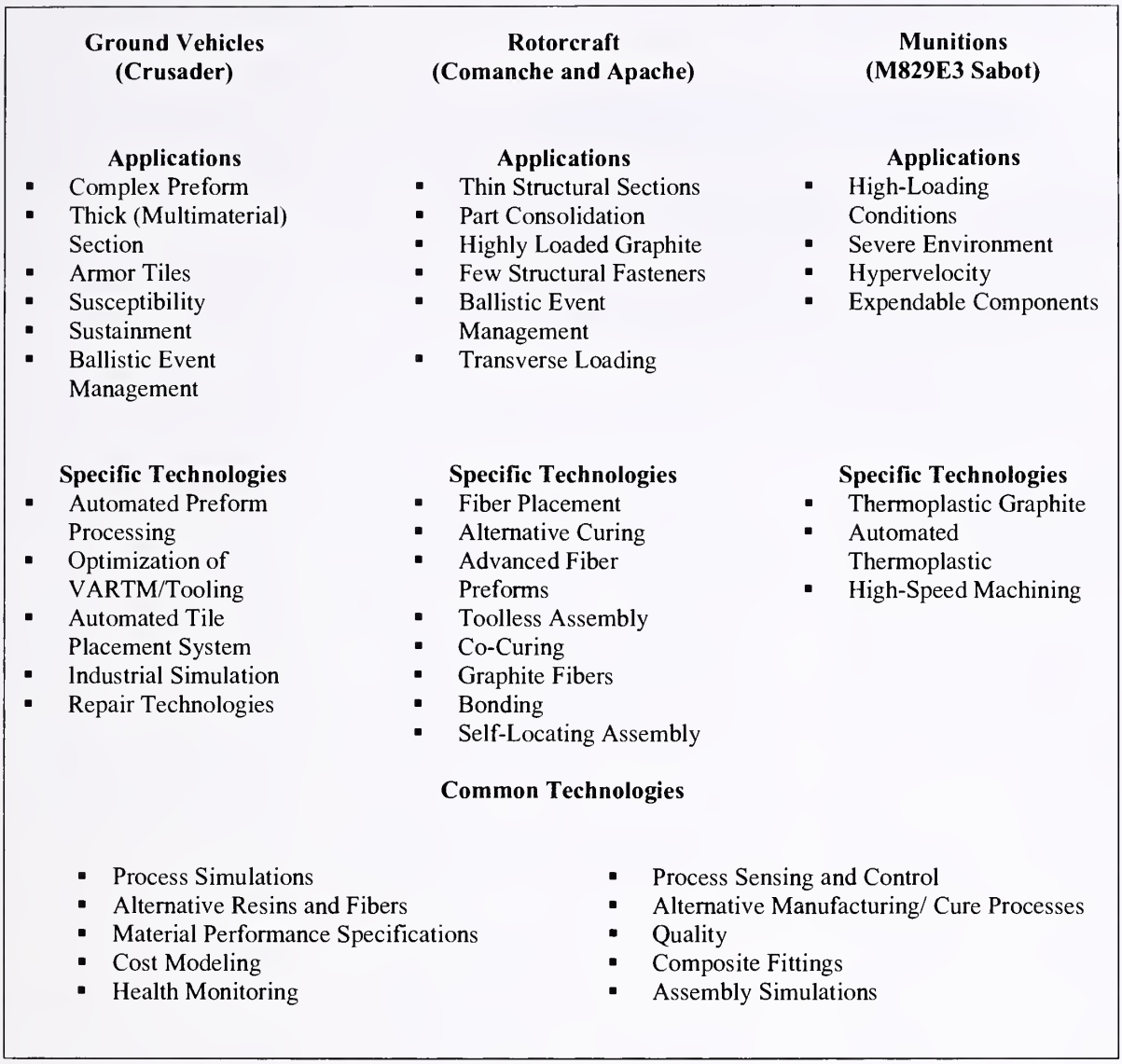

Figure 3.
Technologies and applications

Another area where progress has been made is the development of an e-beam curable adhesive with improved properties. E-beam curing offers the potential to significantly reduce process time for assemblies. Parts of the assembly can be injected with an e-beam resin that will set to a hard but uncured stage, allowing the tooling to be removed. The e-beam adhesive can then be used to bond together the parts, and the entire assembly can be cured at once. E-beam processing is an emerging area where work is ongoing.

To save resources and accelerate the work, the MTO is linked to the CAI. The CAI has a test matrix for e-beam resins to identify those with the best properties and potential for aviation applications. The Army e-beam adhesive is being entered into the CAI test program to achieve a comparative assessment with currently available materials.

Conclusion

The approach taken in this MTO should serve as a model for future efforts, where the resources of other Services are being leveraged into the Army program. Within the Army, multiple major commands, program managers (PMs), and programs are teamed in common pursuit of affordable manufacturing technology for composites development. This approach avoids potential proprietary issues and creates a more uniform capability among the Army's contractor base.

As the demand for new composite technologies (including fibers and resins) increases, costs will decrease. This will ultimately benefit future systems because contractors will have a relatively equal composite manufacturing capability.

Future Army systems, such as the Joint Transport Rotorcraft (JTR), will also benefit from the results of this MTO. The JTR is projected to see a 6-percent cost avoidance in the program definition and risk reduction and engineering and manufacturing development phases based on advances in composite technology through the MTO and leveraged efforts. In addition, the increased use of composites will make possible the goals of a 55-percent increase in range or a 36-percent increase in payload over current baselines.

WALTER ROY is the Chief, Processing and Properties Branch, Weapons and Materials Research Directorate, Army Research Laboratory, Aberdeen Proving Ground, MD.

Army "Wow Projects" . . .

ARMY NAMES R&D ACHIEVEMENT AWARD WINNERS

Dr. Pamela Beatrice

Management consultant Tom Peters describes "Wow Projects" as "projects that add value, projects that matter, projects that make a difference, projects that leave a legacy—and, yes, projects that make you a star" ("The Wow Project," *Fast Company* magazine, May 1999, Page 116). The projects that have been selected for the Army's prestigious Research and Development (R&D) Achievement Awards clearly fall into this category.

The R&D Achievement Awards recognize scientific or engineering achievements that materially improve the Army's technical capability and contribute to the national welfare, and acknowledge scientific or engineering leadership that significantly advances the state of a technology. Each major Army command annually nominates personnel who have conducted innovative and outstanding R&D efforts. Both individuals and small groups are eligible for consideration. The evaluation panel is chaired by the Director for Research and Laboratory Management, Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, and consists of leading experts in the Army science and technology community.

Eighty-seven researchers were selected for an award for 1998 achievements. The projects cover the spectrum of research areas supported by the Army, and all contribute technical and economic value to our national defense. One recipient, Tan Vuong from the U.S. Army Armament Research, Development and Engineering Center (ARDEC), received two awards. James C. Pearson, also from ARDEC, received the fourth R&D Achievement Award of his distinguished career.

Listed by major Army commands, the recipients of Army R&D Achievement Awards are as follows:

U.S. ARMY MATERIEL COMMAND

Aviation And Missile Research, Development And Engineering (RDE) Center

Dr. Kenneth W. McAlister received an award for research on analytical tools for tracking and measuring helicopter rotor wakes. He developed a new optical technique that allows for nonintrusive flow measurement of the complex trailing vortices from a rotor blade. McAlister also pioneered the development of a 3-D laser velocimetry system and designed a triangulating laser light-sheet system to map the geometry of the trailing vortex in forward flight.

Dr. Mark V. Fulton and Dr. Robert A. Ormiston received an award for development of an on-blade active rotor control concept. The active elevon rotor system reduces helicopter rotor-blade vibratory loads by integrating smart structure actuation with on-blade elevon aerodynamic controls to cancel inherent vibratory loads in forward flight. Reduced rotorcraft vibratory loads have the potential to significantly improve mission capability and reduce maintenance and operating costs.

Christopher B. Blanken is recognized for the establishment of new and refined criteria that quantitatively define the roll response dynamics required for a helicopter to perform precise tracking tasks. His work incorporated ground-based piloted simulation in the United States with in-flight simulation in Germany, and has important application in establishing and evaluating flight control laws being developed for the Comanche helicopter.

Allan E. Gamble, Philip N. Jenkins, Michael H. Turner, Christopher E. Roberts, and Brian T. Baeder are commended for their work on the Guided Multiple Launch Rocket System (GMLRS) advanced technology demonstration (ATD). The GMLRS has successfully transitioned to engineering, manufacturing, and development. The team's design and development efforts are credited with successful missile flights. Early tests demonstrated a 150-meter accuracy at a range of 49 kilometers, with one flight impacting only 2.1 meters from the target pole using GPS-aided inertial navigation.

Monte K. Helton and Ricky K. Hammon received an award for their development of the Gray-Level Co-occurrence Matrix Target Trackability Metric for imaging infrared missile systems. This texture-based trackability metric demonstrates a stronger correlation with the observed tracking performance of real systems compared with commonly used signal-to-noise ratio expressions. The metric is now being used as the seeker and autotracker performance specification for new missile system development programs.

Roger P. Berry, Stephen C. Cayson, and John K. O'Neal are recognized for their work on control actuation systems for ATD programs. They designed and developed a Control Actuation System which, when integrated with an inertial measurement unit, GPS unit, and guidance computer, met the precision accuracy requirements of both the Multiple Launch Rocket System and the Long Range Fiber Optically Guided Missile, and the requirements of the Future Missile Technology Integration Program.

Armament RDE Center

Dr. Norman P. Coleman Jr. is recognized for his pioneering research in artificial intelligence and advanced crew station automation technology, and for successful application of this technology to artillery decision aids and the Smart Mines ATD Programs. The Embedded Decision Aids Technology substantially enhances the capability of weapons crew personnel to process digitized battlefield information rapidly and determine an optimal course of action, based on threat/friendly situation and resource constraints.

Dr. Ernest L. Baker, Dr. Brian E. Fuchs, and Tan Vuong received an award for their work in advanced warhead technology that produced the deepest penetration into concrete known for a given warhead diameter. Their resulting model of concrete/penetrator response now allows the development of a family of improved performance anti-concrete warheads.

Dr. Frank J. Owens is commended for the development of an artillery-delivered explosively generated electromagnetic pulse device. By innovatively using powerful permanent magnets as the source of the direct current magnetic field, he designed a

portable device capable of being delivered close to an enemy target while producing a strong electromagnetic pulse intensity that damages the target's computerized battlefield communication systems. A patent application has been filed.

Charles Freud, John Guelph, John Hirlinger, and Dr. Richard A. Beyer are commended for their work on a laser ignition system for medium-caliber weapons. (Beyer is from the Army Research Laboratory.) The team designed a repeatable igniter configuration with environmentally acceptable igniter materials that resulted in rapid ignition performance. Implementation of a laser ignition system increases the safety of future ignition systems.

James C. Pearson, Tan Vuong, and James Pham are recognized for their work on shaped charge design formulas to defeat armor protection systems. Their work resulted in an understanding of the phenomena that control jet breakup time, jet length, and jet cutoff—primary factors determining shaped-charge performance. These advancements have been incorporated into mathematical tools for anti-armor warhead design.

Dr. Steven J. Weiss received an award for his research on superstrate antenna for U.S. Army proximity fuzes. The development incorporated modeling and analysis of complex electromagnetic boundary conditions and used a patented in-house high-dielectric material technology. The superstrate antenna represents a breakthrough for obtaining a high-gain, highly directive antenna containing a single radiating element that until now could only be realized with at least an eight-element array.

Army Research Laboratory

Dr. G. Richard Price and Dr. Joel T. Kalb received an award for their mathematical modeling of hazard-to-hearing from intense sounds. Their models provide accurate predictions of hazards, calculate the effects of hearing protection devices, and provide engineering insight into the development of hazard in the inner ear. These models are already being used nationally and internationally to deal with a wide range of contemporary issues ranging from hazards to children's hearing from cap pistols to the emerging problem of hearing loss from airbags.

Dr. Ronald G. Pinnick, Dr. Steven C. Hill, and Dr. Gorden Videen received an award for their research on the optical characterization of biological aerosols. Their technique distinguishes biological aerosols from natural background aerosols and partially classifies bioaerosol particles. This capability can be used to activate antibody-based or DNA-probe bioagent identifiers and serves to mitigate the dangers posed by biological agents on the battlefield or over civilian population centers.

Dr. Ananthram Swami and Dr. Brian M. Sadler are commended for their work on automatic modulation classification of digital communication signals. The method they developed has low complexity and is robust to various impairments brought about in the demodulation process. The cumulant-based classification is particularly effective when used in a hierarchical scheme, enabling separation into subclasses at low signal-to-noise ratio with small sample size.

Daniel M. Pressel, Dr. Jubaraj Sahu, and Karen R. Heavey received an award for their development and application of new methodologies in high-performance computing for weapon systems design. Their innovative techniques to improve the performance of a large class of scientific computing codes have resulted in improved computational performance of cost-effective scalable computers. Results of their efforts are directly applied to a major aerodynamic code used in the design of future Army projectiles.

Dr. John Noble, Nassy Srour, Steven Tenney, and Dr. D. Keith Wilson are commended for their research on acoustics propagation and technology related to acoustics sensors for Army battlefield applications. This team investigated weather effects on acoustic sensors, using both modeling and experimental techniques, which resulted in enhanced target identification capabilities.

Dr. Donald L. Foster, Dr. Jeff Wolfenstine, and Dr. Wishvender K. Behl are commended for their research on new electrolyte additives for improved rechargeable lithium-ion batteries. The team developed electrolyte additives that prevent solvent from entering the graphite layers and degrading the graphite electrodes. Electrolyte additives allow the use of more energetic graphite negative electrodes and extend the cycle life of lithium-ion batteries.

Herbert A. Brann, James J. Chopack, John Hopkins, and Ronald Tobin received an award for their work on the Remote Activation Munition System (RAMS). RAMS provides an effective, safe, affordable, high-quality, multiuse system to perform a wide variety of missions. Potential civilian applications include avalanche control, forestry work, and commercial demolition.

John Anderson, Lee Butler, Michael Muuss, Robert Parker, and Dr. Paul Tanenbaum are recognized for their work on BRL-CAD™, a modeling software package that provides unprecedented capabilities for simulations of conventional ballistic threats and electromagnetic radiation. BRL-CAD™ incorporates the constructive solid geometry technique of representing geometrical objects and the ray-tracing technique of interrogating databases to achieve high-fidelity simulation. The BRL-CAD™ team also received the 1998 ARL Technical Achievement Award for Engineering.

Dr. Joseph van der Gracht, Dale J. Smith, and Dr. Gary Euliss are commended for their research on computational imaging. Their computational imaging approach distributes the image-formation process between the physical image-gathering system and post-detection digital processing, which provides sharp focus for both distant and near objects. This capability is critical for military vehicles requiring simultaneous knowledge of distant threats and near-navigational hazards and may also provide cost savings.

Dr. T. Richard Jow, Dr. Sheng P. Ding, and Dr. Kang Xu received an award for their research on highly stable and conductive nonaqueous electrolytes for high-energy and high-power electrochemical capacitors. Their use of nonaqueous electrolytes based on asymmetric quaternary ammonium salts produced the salt concentrations, ionic conductivity, and operating voltages required to develop a capacitor having 40-percent higher energy density than that of the present electrochemical capacitors.

Dr. T. Kevin O'Brien is commended for his work on composites durability and damage tolerance. He developed an innovative durability and damage tolerance methodology for composites that predicts life and failure of helicopter composite structures. His research contributed directly to the development of new design methods for rotorcraft. The U.S. helicopter industry is currently using this methodology to design lighter weight, more fatigue-durable, and more damage-resistant airframes and rotor hubs.

Dr. Hiralal Khatri received an award for research on an adaptive-detection system for stationary-target-indication (STI) mode of real-aperture radars. He developed a detection algorithm that autonomously adjusts an STI discriminator to changing clutter backgrounds. This work resulted in the successful completion of an FY98 Science and Technology Objective deliverable.

Dr. Kenneth A. Jones, Charles J. Scozzie, Bruce R. Geil, and Dr. Pankaj B. Shah are recognized for their work on the design, fabrication, and testing of gate turn-off thyristor circuits. The team's research resulted in development of new processing techniques, a new masking procedure, and a revolutionary method for activating the implants by using an aluminum nitride capping layer. This work addresses the Army's need for power electronic circuits for the All Electric Combat Vehicle.

Communications-Electronics Command RDE Center

Michael T. Brundage, Steve Slane, and Anthony J. De Anni are commended for their development of the Land Warrior Day Pack Battery. The team developed a day pack using lithium manganese dioxide battery chemistry packaged in lightweight, volume-efficient prismatic pouch cell enclosures. The Day Pack prototypes exceeded Land Warrior operational requirements and provided 20 hours of operation at room temperature and more than 16 hours of operation at –30 C.

Soldier And Biological Chemical Command RDE Center

Dr. Calvin K. Lee and John E. Buckley are commended for their work on a new opening method for parafoils. The new method rigs the parafoil to open in a streamlined teardrop shape that results in a controlled and staged opening with low-opening forces. This innovative method has been approved for a patent from the U.S. Patent and Trademark Office.

Nicholas P. Rosato, Walter J. Krainski Jr., and John F. Lanza received an award for development of a parachute retraction soft-landing system. Their research involved the design and computer modeling of a "retraction engine" and the engineering scale-up to successfully decelerate a 1,000-pound payload. This innovative method points the way to a simple, affordable, and effective means to soft land heavy payloads.

Arthur H. Carrieri is recognized for his work on a panoramic infrared-imaging spectroradiometer (PANSPEC) with beam broadcasting for chemical vapor sensing, detection, and tracking. PANSPEC is capable of real-time detection of hazardous chemical clouds, tracking of the cloud constituents over a full upper hemisphere field-of-view, and the communication of threat cloud events by the propagation of polarization-encoded electromagnetic radiation. Carrieri received a U.S. patent for this work.

Dr. H. Dupont Durst and Dr. Ray Yin are commended for their research on a dendrimer-based, hand-held nanodevice for biological agent detection. This work incorporates a sensor using nanosized dendimers (3-D polymers) that results in a high sensitivity for detecting a variety of biothreat agents. A hand-held device, significantly smaller than current detectors, was successfully evaluated.

Tank-Automotive RDE Center

Andrew F. Clements, Robert V. Goedert, Dr. Douglas W. Templeton, and Thomas Whittaker III received an award for their work on the development and application of laser-limiting phenomena to laser eye protection. The team provided a firm, fundamental understanding of the critical phenomena of power limiters, which work by undergoing a phase transition upon the absorption of laser energy that scatters or absorbs most of the energy. A prototype retrofit vision system was also designed and fabricated.

U.S. ARMY MEDICAL RESEARCH AND MATERIEL COMMAND

Medical Research Institute Of Chemical Defense

Dr. Clarence A. Broomfield is commended for the development and testing of an altered human protein with the ability to detoxify enzymatically major classes of nerve agents. Most important, this enzyme, after detoxifying one toxin molecule, remains functional and can detoxify additional molecules. This work represents an important advance in the development of biological scavengers that protect against these highly toxic chemicals.

Walter Reed Army Institute Of Research

COL John R. Hess is recognized for directing the development and human testing of a 9-week red blood cell storage solution. His agency and the University of Cincinnati evaluated the limiting problems of the presently licensed 5- and 6-week blood storage systems and identified the critical parameters that extend storage life. The solution will improve the logistics of blood support and has the potential to save the Nation an estimated 300,000 units of blood per year that become outdated.

Dr. Ashima Saxena, Dr. Richard K. Gordon, and Dr. David E. Lenz are commended for the development and exploitation of bioscavengers and immobilized enzymes for protection against chemical warfare agents. (Lenz is from the U.S. Army Medical Research Institute of Chemical Defense.) The team genetically engineered an enzyme that acts as a bioscavenger of organophosphates and is capable of being reactivated for repeated use. They also developed a successful processing technique to make sponge-like foams incorporating these enzymes, which can be used to decontaminate skin, wounds, and personnel.

U.S. ARMY CORPS OF ENGINEERS

Engineer Research And Development Center (Environmental Laboratory)

Brian H. Miles and Javier Cortes received an award for their work on the Site Characterization and Analysis Penetrometer System (SCAPS) Laser-Induced Breakdown Spectroscopy (LIBS) Probe for Detection of Subsurface Heavy Metal Contamination in Soils. They developed, demonstrated, and patented the LIBS probe, which measures the subsurface extent and magnitude of heavy-metal pollution *in situ*, for SCAPS. This technique results in soil characterization with greater speed, higher resolution, and lower cost than current soil sampling and laboratory analysis methods.

DR. PAMELA BEATRICE is the liaison for the U.S. Army Soldier and Biological Chemical Command in the Office of the Deputy Assistant Secretary for Research and Technology, Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology. She holds a doctoral degree in materials science and engineering from the University of Pennsylvania.

Total Packaging Synergy . . .

THE U.S. ARMY INDUSTRIAL OPERATIONS COMMAND'S DEFENSE AMMUNITION CENTER

MG Joseph W. Arbuckle

U.N. Imperative

The golden rule for transporting hazardous materials is "protect the public and the environment." By their very nature and definition, hazardous materials are dangerous, requiring specified packaging protection for movement and handling. Since Oct. 1, 1991, United Nations Performance Oriented Packaging (UN POP) requirements have met this need by imposing a comprehensive, integrated, and seamless packing system. This seamless concept entwines international laws with an intended good will toward each participating country's populace and the world's environment. This system underscores the international community's commitment to the future and the well-being of its citizens and the Earth. In addition, an extreme commitment of financial and natural resources by participating nations is required. They are investing in the immediate resolution of conflicting international laws and regulations, troubling global differences, and leveraging for the best future for our populace.

Hazardous Materials Packaging Logistics

The Secretary of Transportation defines hazardous material as "a substance or material capable of posing an unreasonable risk to health, safety and property when transported in commerce." The logistics of transporting hazardous materials by land, air, and sea is a concept well known to the U.S. government, especially within DOD and the Department of Transportation (DOT). The U.S. government's commitment to action was first recognized by the U.N. community during the Cold War. The United States continues to be the leader in the safe packaging and movement of hazardous materials within its own territorial boundaries, the international community, and on the high seas.

DOT, prior to UN POP standards, provided regulations and imposed congressional law wherein hazardous materials were packaged and transported commercially in the United States and internationally. All other countries also defined and imposed their own laws and regulations for the packaging and transportation of hazardous materials. Because each country defined and imposed its own statutes, international shipments were labor-intensive, often delayed, and frequently costly.

The United Nations has actualized the visionary concept of a seamless, integrated, global transportation regulation, including mandatory packaging requirements. Most members of the United Nations comply with U.N. recommendations. The

A new Army package POP tested and certified by USADAC. This particular package supports overpacking of suspected toxic chemical munitions found on formerly used Defense sites.

U.S. government, through congressional mandate, concurred with the United Nations and, on Oct. 1, 1990, the Code of Federal Regulations 49 (49 CFR) became law. The law is in full compliance with and often exceeds U.N. recommendations.

UN POP Testing

The U. S. Army Defense Ammunition Center (USADAC) Validation Engineering Division, a part of the U.S. Army Industrial Operations Command, is a certified UN POP testing laboratory. The Defense Ammunition Center is located at the McAlester Army Ammunition Plant in McAlester, OK. Since its certification a few years ago, the Validation Engineering Division has certified nearly 100 packages of various types (e.g., wooden boxes, plastic containers, and metal containers). The majority of packages tested and certified have been for the U.S. Army or other military Services. The testing and certification by this division is not limited to U.S. military packages and has included packages from foreign countries and private companies.

One of the distinct advantages of having a package tested by the Validation Engineering Division is the capability of simulating inert items with the same characteristics as the hazardous materials to be packaged and shipped. When a package is tested with these simulated items, test results are more realistic than if the package is just inert-loaded to the proposed shipping weight. In addition, in the case of wooden or metal packaging, this division has the capability to make modifications to the package so that an expeditious solution can be reached with the requesting agency should the proposed package initially fail during the certification process. The UN POP certification testing conducted by the Validation Engineering Division is crucial to our Nation's military readiness, is provided at a reasonable cost, and is accomplished in an expeditious manner.

Considering the turbulent times in which we live, the golden rule of protecting the public and the environment when transporting hazardous materials is more important now than ever before.

UN POP Training

The U.S. Army Defense Ammunition Center's Directorate for Training is considered DOD's foremost ammunition packaging certification trainer. The training directorate offers government and nongovernment employees as well as international military students more than 50 courses geared toward UN POP certification training. The courses are presented as lectures, computer-based training, case studies, and laboratory tests in classrooms worldwide.

The UN POP standards and regulations are critical to several courses. These courses provide mandatory technical information to persons involved with the preparation and shipment of ammunition and other hazardous materials via commercial or surface military transportation.

DOD personnel who certify hazardous materials to U.N. standards on shipping papers, by any mode of transportation, military or commercial, must attend an approved DOD school. The U.S. Army Defense Ammunition Center Directorate for Training has certified thousands of students to the rigid U.N. and DOD standards and is preeminent among the four authorized DOD schools.

Conclusion

Considering the turbulent times in which we live, the golden rule of protecting the public and the environment when transporting hazardous materials is more important now than ever before. Mindful of this fact, the U.S. Army Defense Ammunition Center is doing its part to safeguard our troops, our country, and the international community.

MG JOSEPH W. ARBUCKLE is the Commanding General of the U.S. Army Industrial Operations Command headquartered at Rock Island Arsenal, IL. Prior to his current assignment, he was the Commander of the Armament Research, Development and Engineering Center at Picatinny Arsenal, NJ. Arbuckle has a B.A. in psychology from Western State College of Colorado and an M.S. in systems management from the University of Southern California. In addition, he is a graduate of the U.S. Army Command and General Staff College and the Army War College.

ARMY SUPPORT FOR MANPOWER AND PERSONNEL INTEGRATION

Raymond G. Brandenburg and Dr. Robert F. Holz

Introduction

For the past 2 years, Army executives and a Manpower and Personnel Integration (MANPRINT) General Officer Steering Committee (co-chaired by the Assistant Secretary of the Army for Manpower and Reserve Affairs (ASAM&RA) and the Deputy Under Secretary for Operations Research) have been assessing the need for the Army's MANPRINT Program. After a thorough examination, they determined that the MANPRINT Program is an essential part of the Army's acquisition strategy, which includes reducing the operations and sustainment costs for existing and developing systems.

Executive policies have been published stating that MANPRINT will be applied to all acquisition category systems, will be embedded in the operational requirements document (ORD), will be addressed in source selection, and will be taught to program/project/product managers (PMs) and leaders. Although these policies have been developed and disseminated, did the word really get out to the acquisition community? If participation and attendance at the MANPRINT Symposium held Aug. 18-19, 1999, at the Gateway Marriott Hotel, Crystal City, VA, is any indication, the word is out loud and clear.

More than 140 representatives from various Army acquisition activities attended the 2-day symposium sponsored by the Personnel Technologies Directorate, Office of the Deputy Chief of Staff for Personnel (ODCSPER) at Headquarters, Department of the Army (HQDA). The theme of the symposium was "Shaping MANPRINT for the Next Millennium."

MG John M. LeMoyne, then Assistant DCSPER, gave the welcoming remarks and presented the 1998 MANPRINT Achievement Awards. (MG Timothy J. Maude is now the Assistant DCSPER.) Award winners were as follows:

• Richard Brown, assigned to the U.S. Army Training and Doctrine Command (TRADOC) Program Integration Office for the Army Battle Command System, Fort Leavenworth, KS, was recognized for his work on combat developments.

• Beverly Knapp of the Human Research and Engineering Directorate (HRED), Aberdeen Proving Ground (APG), MD, was honored for her work on human factors associated with the National Missile Defense System.

• David Harrah, Richard Kozychi, and Luci Salvi, all from HRED-APG, were recognized for their work on the Air Warrior Program.

• COL Bruce Jette, PM Soldier, and COL Henry L. Kinnison, TRADOC Systems Manager for the Soldier, received special MANPRINT Achievement Awards for their work in refining and clarifying the requirements for the Land Warrior System.

Keynote Speaker

Following the MANPRINT Achievement Awards, Patrick T. Henry, ASAM&RA, began the formal symposium presentations with a keynote address on some of the major Army issues having MANPRINT implications. An overarching question is, "How do we respond when we are the only power that can meet world needs?" In addressing those needs, Henry said another question arises, "Are we a full-spectrum Army?"

To meet world needs, the Army must attract and retain quality soldiers. The Army has been successful in retaining qualified soldiers; however, it has fallen short of recruiting goals by nearly 7,000 recruits. Because of this shortfall, noted Henry, a major effort is underway to enhance the recruiting program. The Army must not be perceived as an employer of last resort but as a provider of valuable services to our country.

According to Henry, MANPRINT is critical to recruiting and retention because it provides key information about total manpower and training requirements and the skills necessary for a system. Additionally, MANPRINT helps soldiers overcome uncertainty by giving them confidence that the systems they are required to operate and maintain were designed with them in mind.

Requirements Determination

LTG Randall L. Rigby, Deputy Commanding General, TRADOC, addressed the system-of-systems concept reflecting the interaction and interdependence of systems, which demonstrates that the Army can no longer afford to acquire "stovepipe" systems. He assured the audience that MANPRINT is firmly embedded in the requirements determination process. MANPRINT practitioners must, according to Rigby, be core members of integrated concept teams.

Rigby indicated that MANPRINT training courses are taught at the Army Logistics Management College. Additionally, MANPRINT training is included in combat development-related courses and has been added to the military and civilian common core curriculum. TRADOC guidance on MANPRINT, to include its use in writing ORDs, is spelled out in TRADOC PAM 71-9. Rigby noted that of the 47 priority programs assigned to him by GEN John N. Abrams, Commanding General (CG), TRADOC, MANPRINT is priority seven! From TRADOC's perspective, MANPRINT is one of the top 10 programs, concluded Rigby.

Medical Research Support

Shifting to the subject of medical research support, MG John S. Parker, CG, U.S. Army Medical Research and Materiel Command, provided an address on the relationship between medical research and conducting health-hazard assessments. According to Parker, as medical research identifies an issue or risk, that issue or risk can then be added to the items evaluated during the health-hazard assessment process. An example cited by Parker is the need for more research on the effects of nonlethal weapons. With U.S. forces increasingly involved in operations other

than war, the use of nonlethal ordnance must be closely monitored to ensure that lethal injuries do not occur.

Testing And Evaluation

MG Albert J. Madora, CG, U.S. Army Test and Evaluation Command (ATEC), discussed ATEC's evolution to its present structure. He then outlined how MANPRINT interfaces with ATEC Systems Teams. He summarized the MANPRINT payoffs, which include improved manpower usage, reduced training costs, reduced maintenance time, and improved system performance. He assured the audience that MANPRINT is fully integrated into the testing and evaluation process.

Digitizing The Force

Stanley H. Levine, Acting Director, Army Digitization Office (ADO), demonstrated how digitization is far more than materiel. Digitization, said Levine, provides a whole new way of supporting the soldier. The Army is moving to brigade set fielding and the system-of-systems concept, which requires a paradigm shift. Army digitization is MANPRINT's greatest challenge, according to Levine, but the challenge will be met by close interface between ADO and MANPRINT practitioners.

HRED's Approach

The next speaker, Dr. Robin Keesee, Director, HRED, addressed HRED's approach to MANPRINT and its use of MANPRINT tools. When MANPRINT started, the emphasis was on developing tools. Now that the Army has the tools, they must be applied. Keesee noted that Robert M. Walker, the Army Acquisition Executive at the time, decreed that MANPRINT would be applied to all systems. The challenge facing ARL-HRED is meeting that task with the resources presently available.

Teaming—Lessons Learned

L. Taylor Jones, Director, Targets, Test and Evaluation, Military Technologies Inc., a former member of the MANPRINT Office staff and a former PM, reviewed his lessons learned for MANPRINT teaming. He stated that MANPRINT must be funded from system concept through fielding, and there must be qualified personnel to support the MANPRINT effort. MANPRINT domains, according to Jones, must do a better job of identifying costs. MANPRINT must be embedded in solicitation and source selection and award criteria to get the contractor's attention.

Panel Discussions

In addition to formal presentations, the symposium included four hard-hitting panel discussions on MANPRINT-related topics. Panel I, from Team Crusader, discussed managing a MANPRINT Program for a complex system. This panel discussed the need for user juries, Tiger teams, and subject matter experts who are MANPRINT trained. Additionally, the panel agreed that MANPRINT must be represented at the system engineering and integration level as well as on product teams. There must be early management commitment to MANPRINT, and requirements must be resourced. The panel also concluded that a MANPRINT working integrated product team (IPT) should prepare the system MANPRINT management plan (or whatever plan is selected) to identify and track key issues. Applying MANPRINT practices, according to the panel, led to a projected $2.4 billion cost avoidance for Crusader.

Panel II presented an update on MANPRINT regulations. Proposed changes to Army Regulation (AR) 602-2, which addresses the MANPRINT Program, were discussed. Next, AR 70-1 and Department of the Army (DA) Pamphlet 70-3 were reviewed. AR 70-1 will either be replaced or revised. Additionally, DOD Regulation 5000.2-R will be rewritten and will drive Service changes. DA Pamphlet 70-3 was approved on July 15, 1999, and mirrors the contents of DOD Regulation 5000.2-R. The panel made the point that MANPRINT representatives on IPTs must be empowered to offer recommendations to the PM that, when implemented, will result in fielding of improved systems.

Panel III addressed perspectives from the military forces of other countries. Representatives from the United Kingdom, Canada, Germany, and Israel discussed the history, scope, structure, and status of their MANPRINT-equivalent programs. The U.S. Army MANPRINT Program, as the first such effort, provides a benchmark to evaluate other similar programs.

Panel IV addressed MANPRINT tools. Subject matter experts from ARL, the U.S. Total Army Personnel Command, the U.S. Army Safety Center, the U.S. Army Center for Health Promotion and Preventive Medicine, and the ODCSPER each discussed tools used, and in many cases, developed, by their agencies. Their presentations reinforced Dr. Keesee's conclusion that MANPRINT tools are available and must be used now.

Conclusion

The symposium concluded with Dr. Robert F. Holz, Acting Director, Personnel Technologies Directorate, ODCSPER, reminding the audience that resourcing is a key ingredient for a successful MANPRINT program. Additionally, Holz stressed the need for MANPRINT practitioners to work with the PM at the earliest possible stages of the acquisition process. Such early involvement is essential for MANPRINT to have a positive impact because 70 percent of the decision costs for a new system are determined by the end of Milestone I.

Attendees were universal in their laudatory comments regarding the symposium and their recommendations that the MANPRINT Symposium continue to be held annually.

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A Personal Perspective . . .

CONTINGENCY CONTRACTING IN SUPPORT OF TASK FORCE HAWK

LTC Bill Stevenson

Introduction

At 9 p.m., the telephone rang. MAJ Daniel Rosso, Contingency Contracting Officer, U.S. Army Contracting Command Europe (USACCE) answered it. The Command's S3/Contingency Operations Officer asked him if he still had his rucksack packed. Because he was already prepared to deploy in support of Task Force Falcon, Rosso inquisitively asked where he was going. "I can't tell you," said the S3, "but turn on CNN and you'll get the picture." Rosso turned on the television and saw the hour's lead story on the massive Kosovo refugee exodus to Albania. This was the beginning of Rosso's journey into Operation Joint Guardian via Task Force Hawk in Tirana, Albania.

Arriving In Albania

Five days before Task Force Hawk began its tactical combat deployment, Rosso and MAJ Bill McQuail, the Deputy Dispersing Officer of the 106th Finance Battalion, landed in a military C-12 aircraft at Tirana International Airport, located approximately 12 kilometers from the capital city Tirana. They had $700,000 in cash and $2.3 million in Treasury checks in their rucksacks. Nothing was in place—no rental or military vehicles, no cellular phones, no basic supplies; just what they brought with them in their rucksacks. They were armed only with 9mm pistols, in a country with no recognizable federal or municipal government, in a land that has been home at one time or another to almost every major terrorist in the world. There were no tents when they arrived. The first night, they slept under the open sky, waking to the sound of sonic booms overhead coming from U.S. warplanes returning from bombing runs in Kosovo. For dinner, they pooled their rations.

Starting The Mission

The odyssey began the next day. The first task was to lease a rental vehicle. Then they drove to Tirana to locate contractors, construction equipment, and gravel pits; find cellular phones compatible with the local antiquated cellular system; and conduct a market survey to determine what was procurable in the city. On the way, Rosso spotted a large road construction crew doing roadwork. (He knew that Task Force Hawk would need construction equipment to construct earth berms for force protection. A Serbian MiG fighter could take off from Yugoslavia and be over the Tirana airport in less than 5 minutes.) On the way back, he wrote down the name of the construction company. USACCE in central Germany tracked down the company owner in Greece. The information was later made available to Brown and Root Services (BRS) (a subsidiary of the Halliburton Corp.), the U.S. Army Europe (USAREUR) sustainment contractor. During the entire Task Force Hawk operation, the Joint Contracting Center (JCC) also teamed with BRS on virtually all transactions. Contracts were awarded for hauling gravel and rock to the task force location to provide a rough road network as combat equipment arrived and was offloaded from U.S. Air Force C-17 cargo planes.

On the following day, during the first marketing survey visit to the Port of Durres, Rosso saw a truck being loaded with commercial chemical toilets (Port-a-lets) bound for refugee camps. Rosso asked where the company that provided the toilets was located. A quick call to Italy and rapid negotiations allowed Task Force Hawk to procure 22 of its eventual 264 Port-a-lets. Along with contracting for the toilets, trucks and crews from Italy were also contracted to service them. All of these transactions were paid for in cash because the economy did not have a commercial banking infrastructure.

Rosso and McQuail drove into town to purchase goods requested by Task Force Hawk. To make a purchase, they filled out a DOD SF-44, listed every item purchased, had the contractor sign the form, and made on-the-spot payments in cash. Many times these payments took on the flavor of a back-street deal with Rosso negotiating the price and McQuail and the contractors jumping into the vehicle to exchange thousands of dollars in cash for payment. When Rosso and McQuail returned to the Task Force Hawk base, the unit signed the form and took possession of the goods.

As the tactical combat forces began to arrive, the workload expanded immeasurably. USACCE sent three more Department of the Army Emergency Essential Civilians (EECs) from contracting offices in Germany to assist Rosso. When contractor personnel arrived in theater, the JCC provided them with basic needs and office support. In fact, JCC personnel even lived together with the contractors in the same dilapidated building. When the JCC needed reliable communications and fax capabilities, the contractors let them use their equipment. It was a mutually supportive relationship to include exchanging supply sources and pricing information.

The workday was more than 18 hours long with no days off. As more combat troops arrived, the contracting demands increased significantly. Gravel trucks worked around the clock to accommodate the requirements of supporting more than 5,500 combat soldiers. Rosso assigned one of the EECs, Pete Kowolski, to be the "Gravel CINC" (commander-in-chief). His responsibility was to monitor the type and quantity of gravel and verify that it was delivered to the right unit. Kowolski accomplished this by establishing a blanket purchase agreement with local gravel firms and establishing his own fleet of local Albanian gravel trucks to transport the gravel to the installation.

The local Kosovo rock quarry was an invaluable source for obtaining gravel for the installation.

Torrential rains created quagmires for vehicles.

Eventually, the task force established gravel piles, by grade, to speed up deliveries. Combat engineers moved the gravel to the units.

Another EEC, Jeff Hook, became the "CINC for Port-a-lets." He could speak Italian and negotiate with the Italian company that supplied them. Hook was totally engaged in ensuring the chemical toilets were properly serviced for the task force soldiers.

As the combat units' equipment began arriving, so did torrential rains. These near-constant rains flowed off the mountains surrounding the flattened airport runways and into the areas where the task force was located. The soil in these areas, which was primarily clay-based with a thin layer of topsoil, was unable to absorb the rainfall. As such, when heavy tanks, infantry fighting vehicles, and other tracked vehicles moved around, the initial rock roads became quagmires. In particular, the pumping trucks servicing the Port-a-lets bogged down in the resulting mud, requiring a combined D-7 bulldozer and tracked vehicle to pull them down the road to complete their tasks. Another solution was to move the toilets, by hand, closer to the airport runway where the trucks could service them without getting stuck in the mud.

The third EEC, Tom Copeland, managed contracting office operations by tracking (contracting) requirements, monitoring the progress of these contracts, ensuring units signed for goods and services received, and tracking the funds used to pay for purchases. Rosso was continuously involved in meetings, working with contractors, developing new sources, and locating hard-to-find items. Nightly meetings with the Task Force Hawk Chief of Staff, J4 (Logistics Officer), Task Force Engineer, Defense Contract Management Command Administrative Contracting Officer, and the USAREUR sustainment contractor (BRS), were truly the key to integrated contracted logistics success. This teaming effort unquestionably contributed to improved security and quality of life for the soldier. Through teaming and dialogue, priorities and job allocations were given to the activity best suited to get the requirement done.

The success of the Task Force contingency contracting effort was also the result of business relationships based on mutual trust. For example, one afternoon Rosso and Kowolski met with a local contractor at a roadside café outside the back gate of the Tirana airport. During the discussion, the contractor instructed Rosso and Kowolski to quickly but quietly draw their guns ensuring everyone saw them, walk out of the café, get in their vehicle, and drive away. As they departed, the contractor told them, "There is a bad man coming here and you need to go!" Following their departure, the local thug came running in the café looking for Rosso and demanded a portion of the money resulting from the deal made with the local contractor. Thanks to the trusting relationship between Rosso and the local contractor, a confrontation with the local thug was prevented.

Another success story occurred when another local contractor with a gravel truck was put out of business after his truck slid off the road, tipped over, and was totaled. Left with no livelihood, the contractor was convinced by Rosso to establish a new business filling sandbags. About 2 million of them were needed to provide protection from blasts. Rosso showed the local contractor what was required, how to fill each sandbag to standard, and offered to pay 7 cents for each one that met the requirement. He further explained how to hire local laborers and give them a percentage of the profit. During peak production, the sandbag contractor and his crew averaged more than 30,000 bags per day, each filled to standard!

Conclusion

BG William Brandenburg, then V U.S. Corps Chief of Staff, had this to say about the performance of the USACCE contingency contracting officers: " ... [these] folks are great and pound for pound get more done than anyone else." COL Robert Leon, Task Force Hawk Chief of Staff stated, " ... the contingency contracting officers were the unsung heroes of the Task Force Hawk deployment."

Rosso redeployed to Germany shortly after the air war ended, but his stay was very short. He turned around about 2 weeks later and joined the early entry contracting team in Kosovo at Camp Bondsteel in direct support of Task Force Falcon.

Author's Note: MAJ Dan Rosso was previously assigned as a Contingency Contracting Officer at I U.S. Corps, Fort Lewis, WA, and has been a Contracting Officer since July 1994. He is currently assigned as the Chief, Contract Division I, Wiesbaden Regional Contracting Center, Wiesbaden, Germany, a subordinate command of USACCE. He was selected as the Department of the Army's 1998 Outstanding Contingency Contracting Officer (Military).

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AN ARMY TUTORIAL ON ECONOMIC ANALYSIS

Richard M. Williams

Introduction

As the Army leadership explores new ways to improve the efficiency of its current business practices, the application and value of economic analysis has grown. The *Army Economic Analysis Manual* provides Army guidance on detailed economic analysis practices. There are a number of frequently asked questions on the application of economic analysis. This tutorial addresses issues on classification of types of benefits and the recommended economic indicators.

Benefits

Economic analysis addresses two types of benefits—those that can be quantified and those that cannot. Quantifiable benefits can be assigned a numeric value, such as dollars, physical count of items, or number of personnel reductions. Nonquantifiable benefits include improvements in quality of service, morale, quality of life, and wartime benefits. An economic analysis should document both types of benefits.

There are three types of quantifiable benefits: cost savings, cost avoidance, and productivity improvement. Cost savings result when an alternate course of action provides the same capability using fewer resources than were funded and programmed for the current process. A cost savings identifies either excess dollars in the current planned budget or personnel positions that can be terminated, or both. Any cost savings claimed for personnel reductions must be identified to an actual force reduction for military personnel or terminations for civilian personnel. (Alternatively, see discussion of productivity improvement below.) The baseline sources for identifying savings are the president's budget or the Future Years Defense Program (FYDP). For savings that extend beyond the FYDP, the *Extended Planning Annex* is used as the baseline document of record. Within the FYDP, a management decision package (MDEP) must record the planned resource reduction.

The second type of quantifiable benefit is cost avoidance. A cost avoidance results when an alternative course of action produces the same capability using fewer resources, but there is no reduction in programmed resources below the current level. One example of cost avoidance is a proposed reliability/availability/maintainability improvement that will result in future operations and support savings for actions that are neither funded nor programmed. A second example of a cost avoidance is a proposed process that improves the accuracy of a weapon system with resulting reductions to the authorized acquisition objective (AAO), but where the full AAO was not funded or programmed. In both cases, there are no reductions in funded or programmed resources. In addition, any cost reduction beyond the FYDP is a cost avoidance if it is not identified to a specific MDEP.

The third type of quantifiable benefit is a productivity improvement. When a proposed alternative to an existing process forecasts a reduction in associated military personnel within an Army unit or activity, and this reduction *is not* directly linked to a total Army military personnel reduction, this reduction is termed a productivity improvement. Similarly, if a forecasted civilian personnel reduction does not result in terminations but instead results in personnel available to perform other needed functions, this reduction is also categorized as a productivity improvement. Additionally, when a proposed alternative results in a forecasted savings of fewer than one civilian personnel space and that person has the opportunity to perform other needed functions, this reduction is categorized as a productivity improvement.

Indicators

Though quantifiable benefits can be identified either in dollars, number of personnel, and/or measures of performance, in practice they are expressed as dollar equivalents when used in economic indicators. There are a number of economic indicators that analysts and decisionmakers should use to form a more complete assessment with which to compare competing alternatives. A more thorough discussion of these can be found in the *Army Economic Analysis Manual*, which can be accessed on the Army Cost and Economic Analysis Center (CEAC) Web site at **http://www.ceac.army.mil** (click on Publications).

While all indicators should be computed, two of the most useful indicators are the savings investment ratio (SIR) and the benefit investment ratio (BIR). When dollar savings must be identified to meet funding requirements, the SIR is the recommended ranking indicator. The SIR is the ratio of the present value of savings to the present value of the associated investment costs. Similarly, the BIR is the ratio of the present value of the benefits to the present value of the investment cost necessary to produce those benefits.

The Office of Management and Budget annually updates the approved government discount rates used to calculate present value, and these are posted on the CEAC Web site. Net present value and payback period are other useful economic indicators addressed in the manual.

Summary Guidance

Decisionmaking is a complex, multivariable process. Economic analysis provides one set of tools to provide an objective view of competing alternatives. Where these alternatives have different capabilities, the principles of economic analysis can be tailored to address their relative "value." Examples requiring tailoring are the formal analysis of alternatives and cost as an independent variable. Effective analysis requires the analyst to work closely with the decisionmaker, to fully understand the process that is to be analyzed, to assess the available information, and to recommend appropriate evaluation criteria and economic indicators. Even when quality data are sparse or uncertain, economic analysis can provide the discipline to rank competing alternatives.

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CECOM'S STREAMLINED APPROACH TO INFORMATION TECHNOLOGY ACQUISITIONS

Jagjit Gulati

Introduction

According to Steven J. Kelman, writing in the September-October 1997 issue of *Program Manager* [Page 26], "Isles of innovation need to turn into a continent of good business practices." The streamlined information technology (IT) acquisition process provides a flexible vehicle for acquiring state-of-the-art computer equipment that is aggressively priced for Army computer users worldwide. Streamlining government procurement processes through enabling technologies and applying good business practices can produce dramatic results. This article reviews streamlined acquisition guidance from the 1993 National Performance Review, the 1993 Government Performance and Results Act, the 1995 Federal Acquisition Streamlining Act, the 1995 Federal Acquisition Reform Act, and the 1995 Clinger Cohen Act. These laws and associated regulations and policies, government downsizing initiatives, declining budgets, and the thrust toward better performance and use of good commercial practices brought about a change in the attitude of acquisition professionals and how they manage acquisition programs and processes.

Requirements Specification

In past personal computer (PC) procurements, the technical specifications were based on their salient characteristics. Vendors were required to meet each salient characteristic to qualify for any further consideration, which tended to limit the competition. The use of performance specifications for PCs provides vendors the freedom to propose high-performance PCs irrespective of their salient characteristics. The government measures PC performance by using commercially available, unwitnessed performance benchmarks instead of time-consuming witnessed benchmarks or capability demonstrations. The quality of PCs is ensured by specifying industry standards-based commercial off-the-shelf PCs that meet the Gartner Group, Desktop Vendor Tiering Model, Enterprise Tier PC criteria. The Gartner Group Enterprise Tier classification is earned by well-established PC manufacturers with strong histories of profitability and market-share growth and worldwide PC market-share and delivery capability. In addition, these manufacturers have established International Standard Organization certifications for quality production processes and well-established warranty and maintenance support for the life of the PCs. The PC specification also includes compliance with required Army and joint technical architectures for interoperability with the existing PCs in use worldwide. The performance-based statement of work includes commercially available computer software, manuals, and PCs configured as commercially available, bundled systems.

Draft Specification

The draft performance specification is prepared for and released to the vendor community for comments. Vendor comments are analyzed for how they make the necessary adjustments to requirements, if applicable. This process validates the performance requirements for state-of-the-art PC products and their commercial availability including warranty and maintenance support services.

Integrated Product Team

The PC acquisition team is organized as an integrated product team (IPT) consisting of specialists from the technical, contracting, and legal arenas, the Army requiring activity, and a small business advocate. The IPT approach significantly reduces the time required for preparation of a request for proposal (RFP) and its coordination with various specialists. All types of issues related to the PC acquisition are brought to the attention of the IPT for consideration and quick resolution. This results in reduced cycle time for the acquisition process. The IPT also replaces the Solicitation Review Board with empowered team members for final RFP review and release to the vendor community.

Paperless Acquisition Process

The necessary acquisition documents are prepared, coordinated, and distributed electronically in a secure manner, irrespective of where people are located. These documents include the acquisition plan, the source selection plan, and the RFP and its amendments. This electronic document preparation, coordination, distribution, and approval process saves time and travel dollars, speeds up the decisionmaking process, and enhances communications among team members whether they are local or remote.

Use Of Parallel Processes

The use of electronic documents enables the preparation of technical specifications, warranty management requirements, price-analysis methodology, the cost model for evaluation, and the past-performance risk-assessment questionnaire simultaneously to reduce cycle time and to achieve schedule compression. During proposal evaluations, the past-performance reference checks are conducted using the risk-assessment questionnaire, data collection, and data summarization. At the same time, a performance-risk proposal evaluation, to include preparation of items for negotiation, is conducted by members of the Performance Risk Committee. While the committee is awaiting vendor response on items for negotiation, it receives the summarized data to include in the performance-risk evaluation. This parallel process during the RFP preparation and proposal evaluation also reduces the cycle time.

Electronic Communications

All communications with vendors are conducted through a secure Web site. Questions submitted by the vendors about the RFP are received through the Web site, and government answers are provided in a timely manner using the same Web site. Individual vendor questions and answers are made available to all the vendors simultaneously. Negotiations with each vendor are also conducted using the secure Web site without compromising the integrity of the vendor's proposal. Vendor proposals and their updates are received electronically within the designated date and time. The contracting officer considers the date and time stamp placed by the Web site on the received document an official receipt of document. For other communications, both the government point of contact and the vendor point of contact use secure electronic mail. The use of electronic communications significantly reduces the time and cost associated with regular mail and/or express mail.

Oral Presentations

Streamlining initiatives have made it possible for government personnel to conduct face-to-face communications with vendors. After receipt of proposals, the vendors are invited to brief the content of their proposal to the Source Selection Evaluation Board (SSEB). The remote SSEB members participate in this presentation using video teleconferencing. This briefing allows vendors to clarify proposal contents and remove any ambiguities. It provides the vendors an opportunity to explain the value-added features of their proposal and answer questions put forth by SSEB members. It also provides the contracting officer an opportunity to clarify to the vendors that they are responsible for PC configuration management, quality assurance, and performance validation using global requirement certification. The vendors are made aware of the risk associated with noncompliance of the stated requirements. This process reduces the time associated with the proposal evaluation, provides the SSEB a better understanding of vendor proposals, and provides vendors a better understanding of government requirements. Oral presentations allow meaningful discussions with the vendors while reducing cycle time.

Competitiveness

The 1994 Federal Acquisition Reform Act and 1995 Clinger Cohen Act rescinded the Brooks Act and its associated acquisition regulations. This made it possible for the acquiring activities to select a contracting organization of their choice for IT acquisitions. It led to process reinvention to remain competitive with other competing contracting organizations to retain their customers and add to their customer base.

The U.S. Army Communications-Electronics Command (CECOM) Acquisition Center is the recognized Army leader in the acquisition of IT. The competitiveness in contracting organizations fostered responsiveness and innovation that is evident in the streamlining initiatives undertaken by the CECOM Acquisition Center. In the past, PC acquisitions were taking up to a year or more to complete. PC technology was turning over every 6 months. Resultant contracts were providing PCs that were outdated. Today, the CECOM Acquisition Center goal is to complete IT acquisitions for the Army in 120 days or less. Indefinite delivery/indefinite quantity (ID/IQ) contracts can provide current PCs at aggressive prices to Army users worldwide.

Decisionmaking

Centralized decisionmaking is giving way to decentralized decisionmaking in the streamlined acquisition environment. The IPT approach enables decisionmaking at a lower level and reduces the need for higher level management involvement. The contracting officer is empowered to be the Source Selection Authority (SSA) for Armywide PC acquisitions. The Source Selection Advisory Council is no longer needed when the SSEB Chairperson reports directly to the SSA. The key IPT members are Army Acquisition Corps Level III certified and engage in leadership and management practices and processes to maximize value and manage risk. The SSA, with the assistance of the SSEB Chairperson, determines the two overall best value sources for selection. These two overall best value sources are selected to maintain competition between them during the life of the contract. The SSA, in a contracting officer's role, also makes the fair and reasonable price determination in accordance with Part 15 of the Federal Acquisition Regulation. The selection decision authority delegation at the contracting officer level reduces the cycle time to complete the acquisition and build team morale.

Conclusion

The streamlined PC acquisition process results in an ID/IQ contract vehicle to buy better PCs faster at aggressive prices with an affordable total cost of ownership. The IPT process empowers people, measures progress, and removes communication barriers to achieve process improvements to support Army Force XXI vision. The IPT becomes an integrated part of the acquisition process from the start to the finish. This process implements acquisition reform initiatives by empowering the acquisition team and delegating decisionmaking authority and responsibility down to the contracting officer level. It provides a methodology to measure acquisition life cycle and helps compress the acquisition schedule for PCs. For example, the CECOM Acquisition Center successfully completed Army Personal Computer–3 (PC-3) acquisition, potentially valued up to $300 million, in only 127 days using this streamlined process. There were no vendor protests filed upon PC-3 contract award. The improvement in ID/IQ contract processes and procedures results in the availability of improved PC products and services at significantly reduced prices. It capitalizes on acquisition reform initiatives and produces dramatic results in a relatively short period of time. The ability to meet customer needs in a timely and efficient manner is basic for any organization wishing to remain viable.

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CRUSADER SYSTEM ENVIRONMENTAL LIFE-CYCLE COSTS

Mukund Shah, Donald W. Yee, and David Chung

Introduction

All weapon systems have inherent costs associated with them during their life cycle. If identified, these costs can often be minimized early, that is, during the design phase of the life cycle. Unfortunately, while many types of costs are generally well understood and managed from the outset, environmental costs are rarely identified—much less understood or managed—except in crisis situations.

In an attempt to identify environmental costs associated with soldiers operating and maintaining a weapon system, the Project Manager for Crusader (PM, Crusader) conducted a study of the Crusader platform in 1996. The Crusader System (hereafter referred to as Crusader) is the next generation 155mm self-propelled artillery system. It consists of two vehicles, the XM2001 155mm Self-Propelled Howitzer (SPH) and the XM2002 Resupply Vehicle. The Crusader is scheduled for fielding in 2006 and will replace the M109A6 Paladin.

Environmental Stewardship

The Program Executive Officer for Ground Combat and Support Systems (PEO, GCSS) was the first PEO to have one of his project managers demonstrate the feasibility of preparing an environmental life-cycle cost analysis for an item and later for an entire weapon system. The Project Manager, Artillery Munitions Systems (PM, ARMS, formerly known as Project Manager for Sense and Destroy Armor [PM, SADARM]) demonstrated the feasibility of doing such an analysis for an ammunition item during operation and training. PM, Crusader took this to the next level by addressing environmental costs associated with operating and maintaining a major weapon system.

PM, Crusader has consistently maintained a proactive environmental program. In 1993, even though life-cycle environmental documentation was not a requirement for Milestone I, a life-cycle environmental assessment was prepared for the Crusader. The Department of the Army commended this approach and recommended that it be applied to other programs.

Laws And Regulations

Current laws and regulations require PMs to prevent, mitigate, or remediate environmental damage caused by their acquisition programs. In addition, they must perform environmental life-cycle cost analyses prior to each program milestone to determine all direct, indirect, and cumulative environmental effects expected to occur during the system's life cycle.

PM, Crusader recognized that complying with the regulations would not only fulfill a legal obligation, but could also result in cost benefits for the program. A clear understanding of environmental costs would make it possible to "design out" unwanted pollution and potential liabilities, thus reducing overall life-cycle costs.

ELCC Methodology

While regulations mandate environmental life-cycle costing, they do not provide directives on how to do it. PM, Crusader used a methodology called Environmental Life Cycle Costing (ELCC). Developed by the U.S. Army Tank-automotive and Armaments Command's Armament Research, Development and Engineering Center's (TACOM-ARDEC's) Systems Readiness Center, ELCC identifies both obvious and hidden environmental costs, measures them, and sheds light on their root causes and cost drivers.

ELCC methodology consists of collecting data on work performed, identifying environmentally related activities, and using activity-based costing (ABC) to quantify the costs involved in performing those activities.

Initially, individuals representing a specific area or function are asked to identify the work they perform and the resources used to perform it. They are then asked to identify and describe the nature of the environmental work they do and to quantify by percentage the resources consumed in doing that work. The environmental work is classified into four categories: compliance, preventive, corrective, and disposal. After the work data has been gathered, an ABC cost accounting software package is used to translate the collected data into numbers that reflect the cost of environmentally related work. It is important to note that the generated cost data is not auditable. However, it is accurate enough so that managers can make informed and realistic decisions that will lower the cost to perform that work.

Approach Of This Study

Some environmental costs, such as hazardous material disposal costs and environmental office costs, are well known. Others, such as costs related to soldier labor, which are driven by environmental requirements, are not as obvious and have never been documented. Because labor constitutes a substantial portion of the cost to operate and maintain the Crusader, the study team focused its efforts on identifying the impact of environmental activities on soldier labor.

Because the Crusader is still being developed and has not yet been fielded, a blended system consisting of the M109A6 155mm SPH (Paladin), the M992 Field Artillery Ammunition Supply Vehicle (FAASV), and the M1A1 Main Battle Tank (Abrams) was chosen as a surrogate. Although the surrogate vehicles differ from the Crusader, the similarities were

considered sufficient for the purposes of this study.

Soldiers from a field artillery battalion (FA BN) and a cavalry regiment in the 1st Cavalry Division at Fort Hood, TX, were interviewed to obtain firsthand information on activities they perform. Fort Hood is the Army's premier facility for training and deployment of heavy forces, and these soldiers operate and maintain the Paladin, the FAASV, the Abrams, and other combat and support vehicles. The soldiers provided information not only about operation and field-level maintenance at their facilities, but also about maintenance activities performed at the National Training Center in Fort Irwin, CA, where soldiers train under simulated combat conditions.

Twenty-five soldiers from the Paladin FA BN participated in five data-gathering sessions and represented their BN, and eight soldiers from the Abrams cavalry regiment participated in two data-gathering sessions and represented a tank platoon (TK PLT) and a TK company maintenance team (CMT).

Of the 35 duties performed by the Paladin soldiers, 33 were identified as environmentally related. The Abrams soldiers performed 14 duties, all of which involved environmentally related work.

The cost data used in the study to calculate environmental costs were based on the total annual salary of the modification table of organization and equipment units represented in the data-gathering sessions.

Results Of The Study

The results of the study (see accompanying table) show that environmental tasks have a significant impact on duties performed by soldiers who operate and maintain the vehicles representing the Crusader in the field. Environmental tasks account for 18.8 percent of a Paladin FA BN's labor costs and more than 24 percent of both an Abrams TK PLT's labor costs and TK CMT's labor costs (results are given in terms of percentages for purposes of comparison).

Percentage Of Labor Costs Consumed By Environmental Tasks

Environmental Categories	Paladin FA BN	Abrams TK PLT	Abrams TK CMT
TOTAL	**18.8 %**	**24.4 %**	**24.3 %**
Compliance Subtotal	0.7 %	0.7 %	1.8 %
Preventive Subtotal	7.1 %	8.8 %	8.5 %
Corrective Subtotal	6.9 %	12.9 %	6.5 %
Disposal Subtotal	4.1 %	2.0 %	7.5 %

The environmental tasks are broken down by the four environmental categories discussed earlier. For example, for Paladin FA BN, 0.7 percent represents the portion of their total labor costs that is devoted to performing environmental compliance tasks.

Motorpool washrack areas must be able to intercept spills and runoffs.

The study identified spills and leaks of petroleum, oil, and lubricants (POLs) during vehicle and maintenance operations as the biggest environmental cost driver. POLs consist of items such as grease, motor oil, solvent, fog oil, brake fluid, and hydraulic fluid.

The III Corps and Fort Hood have stringent environmental regulations regarding cleanup of spills and leaks as well as storage, use, handling, and disposal of POLs. Post and unit commanders are responsible for overseeing potential environmental impacts of field operations and maintenance activities and for compliance with federal, state, and local environmental requirements. To ensure compliance, Fort Hood's environmental policy states that fines can be imposed by the commander and the state of Texas for any environmental violation.

Specific mandates in environmental regulations include the following:

- "Do not use solvents, detergents, soaps or fuels as cleaning agents on vehicle washracks. ..." Solvents cannot be used to clean the interior and exterior of tactical vehicles. Steam cleaning is the standard method and takes longer.
- "Collect and transport used oil, off-specifications fuel, hazardous waste and salvageable materials generated during field training for disposition. ..."

In the motorpool or washrack areas, steps must be taken to intercept spills and runoffs to reduce POL concentrations entering oil-sand

Drip cans are required to collect POL drips from every combat vehicle.

interceptors. Daily inspections are performed for cleanliness and environmental compliance. Any spill of hazardous material must be cleaned up immediately and reported.

Every combat vehicle at Fort Hood is required to carry a drip can for collection of POL drips when it is parked. Cans are checked frequently to make sure they do not overflow, especially during rainfall. When a vehicle is being worked on in the field, large drip pans and tarps are used. If a leak or spill occurs in the field, the soil must be dug up, bagged, and turned in to the hazardous material collection center to be disposed of as hazardous waste. After a vehicle has been worked on in the field, used hazardous materials and other items like rags and oil filters are carried to a hazardous material collection point or a metals recycling center. Scrapped suspension parts must be cleaned prior to being delivered and placed in recycling bins. Oil filters are placed in plastic bags prior to delivery. Used tarps are cleaned with "dry sweep," which is then collected and bagged.

Application Of Results

By identifying environmental costs and their drivers, this study provides data that can be used by PM, Crusader to evaluate environmental cost impacts of alternative designs. For example, spills and leaks of POL products occur when hose-clamp assemblies are routinely disconnected to perform scheduled and unscheduled maintenance. If quick-disconnect hose assemblies were used in place of hose-clamp assemblies on the Crusader, there would be fewer spills and leaks. Other design considerations that could help mitigate environmental costs related to POLs include the following:

- Providing a single location in the bottom of the hull to easily drain spilled POLs that have collected in the hull.
- Minimizing the amount of rain that can enter the top of the hull by redirecting it. This will preclude the rainwater from being contaminated with POLs, overflowing onto the ground, and causing additional hazardous waste volume.
- Providing better accessibility to the engine and transmission to facilitate maintenance operations and minimize POL spills.

Conclusions

To reduce environmental compliance costs and potential liabilities, and to minimize unnecessary environmental burdens on the soldier, environmental cost drivers must be understood and managed early in a system's life cycle. This study found that soldiers spend a significant portion of their time performing environmental tasks. By analyzing those tasks and their drivers, areas can be identified and addressed to lower environmental costs and enable soldiers to spend more of their time pursuing combat readiness, which is their primary mission. The lessons learned from this study are being incorporated in plans for the Crusader's design and future operating procedures.

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ELECTRONIC SUSTAINMENT SUPPORT CENTERS: REDUCING TOTAL OWNERSHIP COST

Carlton R. Ogletree

Introduction

All project/program/product managers (PMs) want to satisfy their customers throughout the life cycle of their weapon systems. However, this can become complicated when a weapon system is constantly being challenged and improved through advancing technology and revised mission requirements. PMs must continue to provide short-term product support even when new technologies upgrade current systems, in many cases, causing older systems to become obsolete. The Logistics Team in the Office of the Project Manager, Night Vision/ Reconnaissance, Surveillance and Target Acquisition (PM, NV/RSTA) is taking proactive measures to confront this challenge.

PM, NV/RSTA is responsible for multiple weapon systems supporting the warfighter, including thermal sensors and image intensification (I2) equipment that provide the warfighter with the capability to "own the night." To support the warfighter with this equipment, PM, NV/RSTA turned to the Communications-Electronics Command's (CECOM's) Electronic Sustainment Support Centers (ESSCs) for assistance in expediting transfer of failed equipment from the customer to the original equipment manufacturer (OEM) and return. Additionally, PM, NV/RSTA has identified four key areas where ESSCs can provide assistance: improved readiness, shorter cycle time for repair, better accountability, and cost savings.

With the Army changing to accommodate more "power-projection-type" missions, it is imperative that logistics support remain flexible.

ESSCs

ESSCs are regional centers that consolidate the product support management of electronic equipment and systems for military units, both in garrison and during deployments. A government site manager at each ESSC surveys the activities of the service providers to identify unique and shared capabilities that, when applied against existing or projected requirements, will result in cost savings to the Army. Service providers include government representatives, support contractors, OEMs, and military maintenance technicians.

ESSCs provide system and/or product support on a repair-and-return-to-user basis. Maintenance personnel from ESSC Regional Support Centers (RSCs) or technicians at a contractor or government depot make repairs. Additionally, ESSCs collect and evaluate maintenance data to determine operational effectiveness and identify methods to enhance readiness, reduce maintenance turnaround time, streamline repair processes, organize and consolidate resources, increase responsiveness, and control costs.

ESSCs also provide sustainment maintenance support services, product support services, and warranty support services to multiple program executive offices (PEOs) and their associated PM offices through service providers. These services offer the Army an effective and cost-efficient method to address product support issues. In addition, ESSCs can provide centralized management of critical, expensive, and low-density spares and repair parts. ESSCs also have the capability to act as forward supply activities, thereby reducing authorized stockage list requirements (and associated costs) and providing greater visibility of on-hand assets.

Identifying Problems

In the past, PM, NV/RSTA experienced major problems in supporting fielded weapon systems. These problems included excessive turnaround times on warranty items, inadequate tracking capabilities of deficient systems, lack of maintenance support at the user level, and a deficiency in sustainment training for user personnel.

Reports from a fielded location in reference to I2 devices revealed several causes of excessive turnaround times. First, because of higher priority missions or manpower shortages, some units perform sporadic turn-in of deficient equipment. This causes the quantity of equipment for each turn-in to be too large. When this happens, an in-processing backlog in the direct support maintenance facilities results in large quantities of equipment being returned to the OEM under one return authorization (RA) number. In turn, maintenance facilities then

Current Versus Projected Timelines For Failed Item

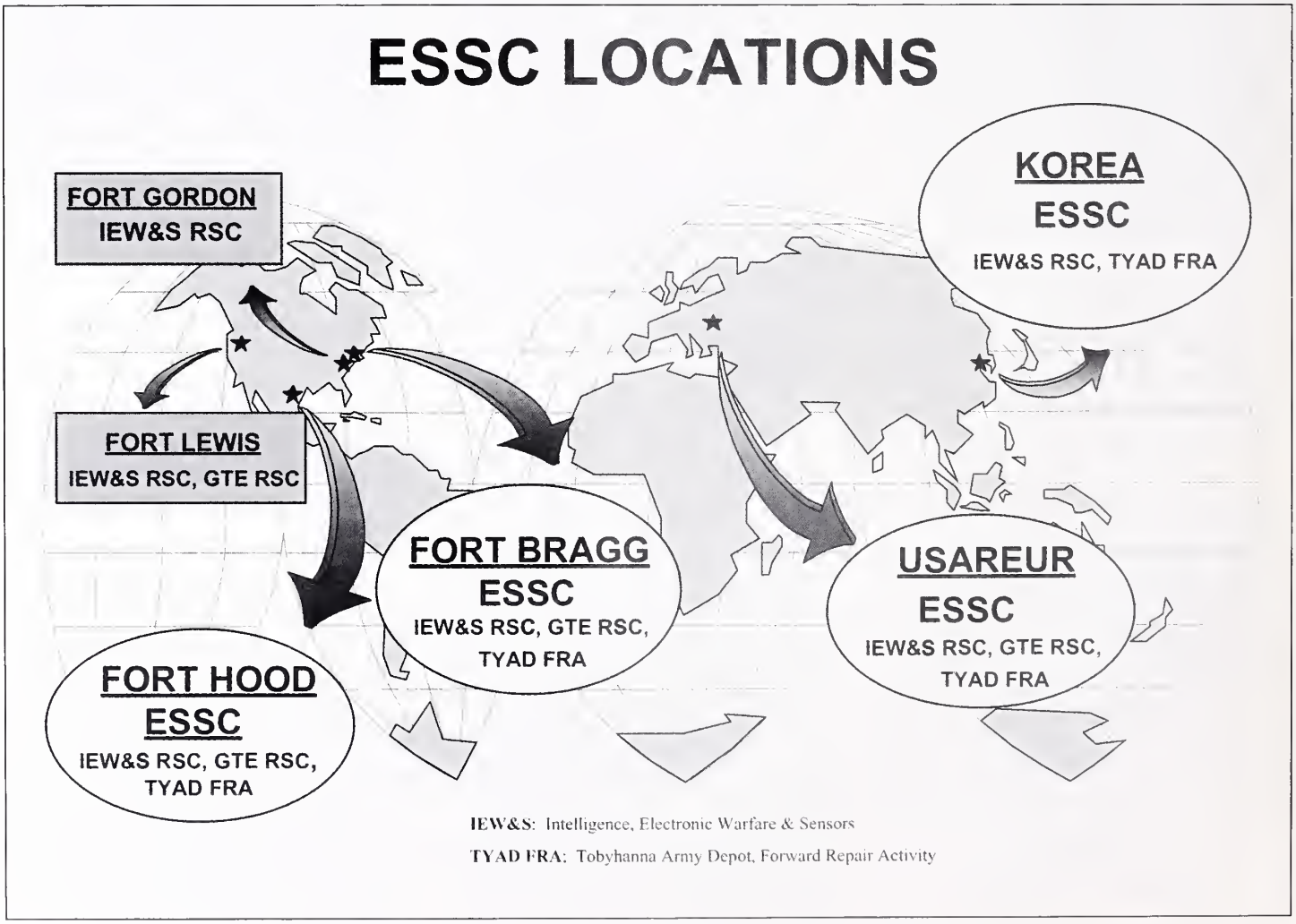
	USER LOCATION	TRANSIT	GOV INSPECT	MANUFACTURER	RETURN
CURRENT	23-35 days	4-6 days	6-12 days	32 days (avg)	10-18 days
PROJECTED	12-22 days	3-5 days	6-12 days	15 days (avg)*	6-10 days
CHANGE	(-)11-13 days	(-)1 day		(-)17 days (avg)	(-)4-8 days avg

* Average days at the manufacturer can be decreased. More efficient methods of shipping and realistic return criteria will improve the OEM turnaround time.

send large quantities of equipment to the Materiel Maintenance Branch, which also packages and ships under one RA. Multiple systems turned in using one RA number can cause delays. Second, maintenance facilities do not send "like" failures in one batch. Finally, customers often release the OEMs from their contracted warranty turnaround times to avoid accepting partial returns. For example, some warranty control officers require that all defective items shipped under one RA number be returned in their entirety, causing excessive delays.

Identifying the causes of delays and formulating corrective actions is difficult and sometimes impossible because of the inadequacies of the current tracking system from user to OEM and return. OEMs seldom see any original paperwork (DA Form 2404, DA Form 2407, maintenance request, or other such documentation), necessitating a second evaluation of the item to determine its deficiency.

Unit-level maintenance support has decreased because customers have difficulty understanding and adjusting to the 31U, unit-level maintainer, and guidelines to troubleshoot, repair, and replace night vision systems or to comply with their warranty requirements. Additionally, users are unable to maintain operational or maintenance proficiency because of a



lack of sustainment training. For many weapon systems, sustainment training is conducted or supported through the CECOM Logistics Assistance Representative (LAR) at each major installation. Also, because of limited resources, there are not enough LARs to support all weapon systems.

Solutions

Concerned about the problems experienced by the user community, the PM, NV/RSTA Office held a meeting with its personnel and those from the CECOM Readiness Directorate ESSC. The Office of the PM, NV/RSTA personnel were impressed with the CECOM Readiness Directorate ESSC's idea for system support. After reviewing some sample systems, CECOM Readiness Directorate's ESSC determined that PM, NV/RSTA's customers and systems would be better supported through quicker turnaround times, accurate tracking, reliable and qualified maintenance support, and up-to-date sustainment training.

With the Army changing to accommodate more "power-projection-type" missions, it is imperative that logistics support remain flexible. Under the new revolution in military logistics concept, forward support to deployed units must effectively combine traditional military support organizations supplemented and augmented by contractor personnel. This concept is fully embodied by ESSCs that have been established both in CONUS and overseas.

Using ESSCs as conduits for returning defective night vision equipment to the contractor's depot facility, Army activities will ensure a faster turnaround and improve asset availability (see table on Page 36).

The ESSC RSCs personalize their service by maintaining real-time contact with the user. As equipment is determined to be deficient, the user can contact the RSC help desk and receive immediate instructions, which may include picking up the equipment and returning it when ready.

To resolve tracking problems, RSCs use the Maintenance Tracking System and Site Administration (MTSSA) database. MTSSA is specifically designed to automate maintenance and logistical duties while simultaneously collecting a wealth of meaningful repair and maintainability data for customers and senior managers. MTSSA was designed specifically for use by technicians in the field to automate data entry and provide an electronic connection between parts, logistics, and paperwork requirements.

MTSSA offers all labor disciplines the opportunity to record man-hours and expenses against a job while also completing everyday forms and reports. MTSSA provides total accountability for what is required to accomplish the job. Data entered to create an everyday maintenance request, logistical support form, shipping invoice, site check, or timecard are automatically available for re-use not only within the MTSSA structure, but also in other database or spreadsheet programs. MTSSA's analyses of cost avoidance, parts usage and failure, mean time between failure, labor category and manning requirements, and other direct costs were very important tools for PM, NV/RSTA to use in tracking weapon systems.

To resolve training issues, RSCs are staffed with skilled technical personnel. However, the PM will continue to rely on the LAR support base coupled with technical support from PM, NV/RSTA personnel for primary sustainment support.

One of the advantages of ESSCs is their ability to deploy in support of multiple regional conflicts. ESSCs provide sustainment maintenance support to the Army Materiel Command Logistics Support Elements (LSEs). Integral to force projection strategy, CONUS ESSCs will deploy task-oriented cells to support units normally located in their CONUS area of responsibility. During deployment, ESSC cells will fully integrate into the LSE. As part of the LSE, ESSC cells will centralize management of contractors performing maintenance and repair on electronic systems and equipment at locations within their area of operations.

PMs will use elements of the sustained maintenance planning approach to continually review established maintenance plans and ensure that they are cost effective and address any potential changes in materiel condition, system age, and operational environment.

Conclusion

The PM, NV/RSTA recognizes that constant technological breakthroughs require adequate support of fielded weapon systems to ensure their operational effectiveness. Often, it is not cost effective for a PM to rely solely on contractor logistics support for short life-cycle weapon systems. ESSCs can provide the support necessary to satisfy users during transitional periods between obsolete and new-generation systems. Although there will be upfront costs in establishing ESSCs, the future cost savings will be substantial and evident.

PEOs and PMs can incorporate the ESSC concept into their acquisition and product support strategies, creating a "win-win" situation. PEOs and PMs can realize cost reductions by using existing maintenance capabilities versus proliferating "stovepipe" systems. ESSCs can realize cost reductions by increasing their customer base. ESSCs offer the Army an opportunity to establish a consolidated electronic product support maintenance approach that will improve unit readiness, shorten the cycle time for repairs, and create improved equipment accountability and availability at a reduced cost.

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Doing Something For The Soldier . . .

IMPROVEMENTS TO THE MEAL, READY-TO-EAT

Judith M. Aylward and Joseph A. Zanchi

Introduction

The Meal, Ready-to-Eat (MRE), which replaced the canned Meal, Combat, Individual (C Ration) in the early 1980s, is the current standard individual military operational ration. The MRE is a totally self-contained, flexibly packaged meal used by U.S. Armed Forces in the field. The Services use the MRE to sustain individuals during operations where organized food service facilities are not an option, but where resupply is established or planned. Modern military operations require ration systems that adequately provide for the needs of the individual in extremely intense and highly mobile combat situations. The MRE clearly answers this requirement unlike any other combat ration in history.

Withstanding Requirements

Numerous considerations must be addressed if an acceptable ration product is to be provided to American military personnel. Ration development considerations include nutrition, personnel acceptance, wholesomeness, producibility, cost, self-heating capability, modularity, weight and volume, ease of sanitation, menu fatigue, and performance enhancement. They must also have a minimum shelf life of 3 years at 80 degrees Fahrenheit and 6 months at 100 degrees Fahrenheit, be highly acceptable, and meet the Office of The Surgeon General's (OTSG's) nutritional requirements as identified in the *Nutritional Standards for Operational Rations* (AR 40-25). In addition, packaging must meet stringent durability requirements to allow for airdrops, rough handling, and temperature extremes as encountered in global, force-projection military operations. Without question, these are an extremely demanding set of operational performance requirements by any measure.

Improved Technology

As a result of research and development breakthroughs, MREs are lightweight, compact, and easily opened. In addition, they can withstand parachute drops from 1,250 feet or helicopter drops with no parachute at 100 feet, endure inclement weather, and survive temperature extremes from minus 60 degrees Fahrenheit to 120 degrees Fahrenheit.

Each meal contains approximately 1,200 calories and includes an entrée or starch, crackers, a spread (cheese, peanut butter, or jelly), a dessert or snack, beverages, an accessory packet, a plastic spoon, and a flameless ration heater (FRH). The FRH is a water-activated exothermic chemical heater designed to raise the temperature of the 8-ounce entree of the MRE by 100 degrees Fahrenheit in 12 minutes. The FRH has proved to be an effective method for the individual soldier to obtain a hot meal on demand in the field. One FRH has been included in each MRE meal bag since assembly of MRE XIII, 1993 date-of-pack.

Flameless ration heater

The MRE flexibly packaged foods are heat processed in "retortable" pouches. Retort describes a thermostabilization process much like canning. The pouch material has several layers and is similar to a flexible can. However, the pouch has better storage and distribution qualities than a can, without the bulk, weight, or need for a can opener. The pouch is filled with the food product then sterilized in large pressure cooker-like equipment. This process gives the product a long shelf life and helps retain natural juices and flavors for greater acceptability.

More Improvements

Under the auspices of the DOD Combat Feeding Program at the U.S. Army Soldier and Biological Chemical Command's (SBCCOM's) Soldier Systems Center (SSC) in Natick, MA, research and development efforts each year have resulted in significant customer-driven improvements. These efforts have expanded the variety of products and improved their acceptability, consumption, and nutritional intake while minimizing product weight and volume.

Industry Involvement

Since its introduction, the MRE has undergone continuous improvement. All proposed changes to the MRE menu undergo a series of laboratory tests as well as sensory and operational evaluations with users in the field. The results of user suggestions and field evaluations drive many of the changes to the MRE. These rapidly fielded, customer-focused improvements are implemented through the effective work of the Combat Ration Integrated Product Team (IPT), whose key members include the customer, the combat developer, vendors, the materiel developer, and the procuring agency.

Since the introduction of MRE XIII, more than 80 new items, 70 percent of which are nondevelopmental commercial items, were approved for the MRE. In addition, 16 of the least acceptable items were replaced. The number of menus increased, incrementally, from 12 to 24 to include four vegetarian meals packed two to a case. A new easy-open meal bag with commercial-like colors and graphics has also been added, along with nutritional labeling and application of time-temperature indicator (TTI) labels on all MRE ration cases. The use of

TTIs will facilitate rapid and effective quality monitoring and stock management of pre-positioned MREs.

As a result of a Military Ration Nutritional Analysis and Labeling IPT initiated by SSC, contractors will now provide computer-generated nutritional analyses for all operational ration military specification and performance contract requirement items beginning with MRE XX, 2000 date-of-pack.

Nutritional analysis is critical to enable Combat Feeding Program food technologists to design recommended menus and ensure that rations provide adequate nutrition as mandated by OTSG. This process allows greater flexibility for the vendors and enables unprecedented speed and reliability for computerized formulation and analysis as well as real-time data reporting and delivery via the Internet. Nutritional analysis typically includes elements such as kilocalories, protein, carbohydrates, fat, sodium, and a broad range of vitamins and minerals.

The proposed breakout for mandated product nutritional analysis includes 17 nutritional components per 100-gram portion size required by OTSG. Suppliers of military-unique items, such as entrées and wet-pack items, will submit nutritional data with the first production contract and each subsequent major formulation change. The result is significant savings in both time and money over tedious, expensive, and time-consuming nutritional analyses. More importantly, this tool ensures that soldiers receive a ration that meets the requirements of AR 40-25 for maximum health and performance.

The highly successful effort of the Military Ration Nutritional Analysis and Labeling IPT is a clear example of government and industry working together to provide the warfighter with a highly acceptable, nutritionally complete ration.

New MRE Items

A number of new MRE component items were recently approved by the Joint Service Operational Ration Forum IPT for inclusion in MRE XXI, 2001 date-of-pack. New entrée items developed at SSC and recommended and approved for MRE XXI production include jambalaya and enchiladas. In addition, several new entrées were approved for use as needed, including chicken nuggets with cavetelli, mesquite chicken breast, and beefsteak with mushroom gravy. Additional approved items include wheat snack bread, plain snack, mashed potatoes added as a starch in applicable menus, spice poundcake, peanut butter cookies, pretzels filled with nacho cheese and cheddar cheese, chocolate chip cookies, and snack cereals. Finally, a new light green camouflage color was approved for the MRE retort pouch, which provides a readily producible product with increased camouflage properties for reduced signature.

MRE items

Conclusion

The continuous improvements and innovations in MREs clearly indicate the Army's steadfast commitment to customer satisfaction. For example, the quality and variety of MRE products, each designed to meet nutritional requirements of AR 40-25, are truly remarkable. During a recent ration sampling by some of the highest-ranking military officers assembled at the Pentagon, GEN Henry H. Shelton, Chairman of the Joint Chiefs of Staff, perhaps summed it up best, "The quality is very, very good—probably as close to home cooking as you can possibly find ... the modern technology we've got today, and continuing to improve, it's absolutely phenomenal."

Current and future initiatives will provide the technology to continuously improve the MRE by providing soldiers sustained energy, mental alertness, and eat-on-the-move capability while reducing the MRE weight and volume and improving logistics. The DOD Combat Feeding Team is hard at work every day in search of new solutions and capabilities to leverage revolutionary technologies that support U.S. military objectives and sustain and provide the soldier's decisive edge. It is this technological edge that has served the U.S. military so well and will continue to lead us into the 21st century.

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JOSEPH A. ZANCHI is a Logistics Management Specialist assigned to the Combat Feeding Program at SBCCOM's SSC. He has a B.S. in business administration from Babson College, a certificate in project management from Boston University, and has completed graduate work in business and systems engineering at Western New England College.

ETHICAL LEADERSHIP IS THE KEY TO CORPORATE SUCCESS

CPT Jeffrey C. Grover

Introduction

Within the past 5 years, a U.S. Defense contractor fell victim to unethical actions by its employees. It agreed to pay millions in penalties because employees illegally bribed a foreign official to gain help in winning a weapons contract. This is but one example of illegal and unethical activities that have plagued organizations in America. Fraud, price fixing, sexual harassment, customer overcharges, and corporate scandals all demoralize employees, rile investors, and drive away potential customers.

For Defense contractors, the *Federal Acquisition Regulation* (FAR) and the *Defense Federal Acquisition Regulation* (DFAR) provide general policies, standards, and procedures pertaining to ethical business practices. Although the information covered in these regulations is broad in scope, it provides the foundation for a Defense contractor's ethics program.

Today's business climate presents many challenges to the Defense contractor when it comes to addressing ethical practices. A survey conducted in early 1997 and published in *Workforce Magazine* found that 56 percent of workers feel some pressure to act illegally or unethically. An astonishing 48 percent of those polled admitted to having engaged in one or more unethical and/or illegal actions in the previous year. Business organizations lacking sound ethical leadership will face a never-ending battle with unethical practices by its employees and should be considered a business-at-risk.

The public and the business community in general quickly form opinions about individual companies by applying a universal set of values to a set of actions. Nothing influences a corporation's bottom line more than public backlash against a company that acts unethically.

One way to better predict employee behavior is to create a nurturing business climate where employees are given the tools and motivation to conduct ethical practices within the organization.

Members of the Army Acquisition Corps and military procurement community in general need to reaffirm the fundamental ethical requirements expected of Defense contractors. This article suggests some sound ethical principles for Defense contractors and promotes the idea that by displaying a strong commitment to ethical leadership, a Defense contractor's management can ensure that employees behave properly.

The Ethical Environment

The ethical environment consists of an external component and an internal component. The external component includes public opinion, legal and political pressures, and shareholders' and constituents' views. The internal component encompasses the attitudes of the leaders and employees of the organization.

In addition, the ethical environment can be viewed as a pyramid divided into four parts:

- The base or ethical awareness is the set of moral standards and values employees have acquired since birth.
- The lower-middle or ethical reasoning is the set of internal influences from which employees make decisions.
- The upper-middle or ethical action is the set of activities employees perform.
- The peak or ethical leadership is the one and only internal component within the ethics environment that can influence employees, and that is the focus of this article.

Ethical leadership can be viewed as the point where an organization's ethical culture comes to life.

Why Focus On Ethics?

Ethics is essentially about human behavior, and if we understand human behavior in an organizational context, we can better understand and manage ethical behavior. In the Defense industry, when negotiating millions of dollars a year in sales, one cannot assume that all employees have the same ethical integrity to conduct business with the government. Managers must make ethical business practice an organizational priority.

The basic definition of ethics is "a set of moral principles or values." An expanded definition is "a system or code of morals and conduct of a person or group." By using the expanded definition of ethics and assuming that ethics can be taught, the actions of individuals become an extension of good leadership.

Ethically managed companies focus on making a profit while at the same time acting responsibly and respecting ethical principles. For ethical management to be effective, individual managers must display their support for it through leading by example in their day-to-day interaction with their employees.

Leaders create culture! Top management's role is particularly important. It is not simply financial and administrative, but also social, political, and moral. Leadership is a critical component of the organization's culture because leaders can create, maintain, or change culture. Leaders can help maintain the current culture or change it by articulating a vision; by paying attention to, measuring, and controlling certain activities; by making critical policy decisions; and by recruiting and hiring personnel who fit their vision of the organization. Leadership is the most crucial ingredient in an organization's culture because integrity, or lack of it, flows from the top down.

Ethical Leadership

Why is ethical leadership at the peak of the ethical environment pyramid? It is at the peak because it signifies the ultimate goal of every organization—to achieve success and improve the "bottom line" honestly and legally. In the most successful companies, every individual on the corporate ladder, from the mailroom

clerk to the CEO, has a shared responsibility to be a moral leader. The ultimate goal is to achieve individual and institutional integrity.

Communication Is The Key

Ethical leadership is rooted in effective ethical communications. Effective ethical communication flow is downward, upward, and two-way. This is essential if the organization is to have a strong and aligned ethical culture.

Ethical communication should communicate values, standards, and policies; be synergistic, clear, consistent, and credible; use a variety of media (video, Internet/intranet, correspondence); and use formal (written or spoken) and informal ("grapevine" or passed by employee word of mouth) communication systems.

Leaders and managers must identify appropriate and inappropriate conduct and convey these standards to their employees. These expectations of their employees are most effectively communicated through ethical codes of conduct and employee training programs.

Most people believe that law-abiding behavior is also ethical behavior. But there are many standards of conduct agreed to by society that are not written in law. Many organizations guide employee behavior through ethical policies, codes of conduct, and sound leadership.

Ethical Codes Of Conduct

Ethical codes are ground rules for ethical conduct within an organization. They are written, normally in bullet format, and presume to state the major philosophical principles of an organization and its values and beliefs. The following is an example of ethical codes of conduct used by a leading Defense contractor for rotary-wing aircraft:

- Achieve a win-win relationship with customers and earn business fairly.
- Employees have an equal opportunity to advance and work in an environment free of harassment and abuse.
- Maintain work environments that are safe and clean.
- Provide a vehicle for employees to be heard without fear or retribution.
- Be responsive to the long-term goals of the shareholders.
- Develop cooperative relationships with suppliers.
- Be a good corporate citizen by complying with all the laws, supporting community involvement, and protecting the environment everywhere we engage in business.

These codes express the organization's ethical norms and values. They are the foundation of the organization's ethics program.

Ethical codes of many business organizations focus on unethical behavior and have the potential to influence profits, but show weak commitment to social responsibility by their employees. The problem facing many Defense contractors is that most codes fail to provide strong guidance. They are too absorbed with legalities and profits, and they are poorly written.

Successful codes of conduct are periodically reviewed and updated, based on strong corporate values, and written in a style that is open, interesting, and free of technical and legal jargon.

Clearly, codes should be written with explicit meaning and content, and focus on the target audience—the employees who read them.

Employee Training

One way an organization can communicate its values to individuals is through formal (new employee) orientation programs and (existing employee) ongoing ethical training programs. By providing ethics training, an organization not only offers specific skills to its employees, but also directly communicates that ethical behavior is valued and that ethical issues should be considered in the decisionmaking process. These programs should teach and reaffirm what the company expects of the employee and underscore the ethical foundation on which the company is based. Ethical training programs should be tailored to a target group and provide clear informative dialogue on what type of climate the company wants.

An effective training tool is video technology. Recently, a leading Defense contractor distributed an ethics training video showing the CEOs of both the parent company and Defense contractor discussing the importance of ethical business practices. One CEO states, "Combining profitability and ethics is not only possible, but is an imperative." Another CEO explains that his corporation's strong financial performance is based on a strong foundation in ethics. He later states, "Shareholders, customers, and the community demand a business environment based on trust and credibility." The only way to develop an excellent reputation and provide the best-valued product in the market is to spend the time and money and hire the people needed to enforce sound ethical practices to improve the "culture of compliance."

Conclusion

Ethics in Defense contracting today is the most important ingredient for success. Sound ethical leadership is fundamental to value-based contracting. In addition to strong ethical leadership as the foundation for an ethical organizational culture, an organization needs commitment. Commitment is necessary because an ethical business is only as effective as the people (management, employees, customers, and community) who are involved. Obeying the law is simply not enough. An organization must also be committed to improvement. Ethical organizations are responsible organizations focused on future business potential and not exclusively on short-term gains.

Finally, studies have shown that employees who resolve ethical dilemmas and conduct themselves ethically face less job-related tension, frustration, and anxiety. This results in higher performance and lower employee turnover. There is a strong correlation between ethics, socially responsible performance, and long-term profitability. Pride, loyalty, integrity, and honesty go a long way in Defense contracting. The bottom line is that ethical business practices by Defense contractors initially pay off in winning the contract and continue to pay off by avoiding costly litigation and lost business.

CPT JEFFREY C. GROVER was pursuing an M.B.A. at the University of Texas at Arlington and participating in the Training With Industry Program at Bell Helicopter, Fort Worth, TX, when he wrote this article. He also holds a B.S. degree in economics from James Madison University. Grover is now serving as a Contingency Contracting Officer with the 7th Transportation Group, Fort Eustis, VA.

DEMIL VERSUS ACQUISITION

Gary L. Lawson and Thomas H. Howell

Introduction

Large quantities of tactical missiles were procured and stockpiled during the Cold War. As their service life rapidly approaches expiration, program managers (PMs) are faced with a great challenge. Life-cycle cost (LCC) models are developed and used to support acquisition activities by PMs and acquisition executives. (See "Life Cycle Cost Drivers From The Program Manager's Perspective," Page 10, *Army RD&A* May-June 1998 issue.) These are well documented for development, acquisition, and deployment ownership cost. Typically, however, the cost to demilitarize, or "demil," these assets is not included in most LCC models. Yet, PMs' responsibilities truly encompass "cradle-to-grave" functions. The Close Combat Anti-Armor Weapon Systems (CCAWS) Project Office has recognized this challenge and developed a plan to reduce the cost to demil Tube-launched, Optically-tracked, Wire-guided (TOW) missiles. By using discretionary initiatives to minimize the demil quantity and recycling techniques that provide a revenue stream, a plan has been developed to significantly reduce the cost to demil TOW missiles—potentially to zero—with industrial partnerships. These costs will be comparable to open burn/open detonation (OB/OD) without incurring environmental liabilities.

Background

Demil costs threaten force modernization objectives with significant budgetary pressures. In August 1997, Dr. Kenneth J. Oscar, then Acting Assistant Secretary of the Army for Research, Development and Acquisition (now Deputy Assistant Secretary of the Army for Procurement) and LTG Paul J. Kern, Military Deputy to the Assistant Secretary of the Army for Research, Development and Acquisition (ASARDA) (ASARDA is now Assistant Secretary of the Army for Acquisition, Logistics and Technology), challenged the Program Executive Office, Tactical Missiles (PEO, TM) to develop a plan that reduces or eliminates demil costs.

The U.S. Army has a compelling need to develop a cost-effective, environmentally safe alternative to OB/OD. Within 5 years, the shelf life of more than 80,000 U.S.-owned TOW missiles will expire, with others expiring soon after. Because of potential environmental liabilities and compliance to criteria established in the new Munitions Rule Implementation Policy, the cost to demil the Army's TOW inventory will most likely approach $200 million. This is a worldwide problem because more than 42 countries own TOW missiles.

The CCAWS Project Office developed discretionary initiatives (i.e., live-fire training, Foreign Military Sales (FMS) "giveaways") and incorporated resource recovery and recycling (R3) technologies to reduce the cost to demil TOW missiles. The discretionary initiatives can potentially reduce the quantity for demil by approximately 10 to 20 percent. However, more than 140,000 TOW missiles would remain. The R3 technologies can generate a revenue stream from the inherent value of energetics, electronics, and metallic components in the missile. Applying R3 technology will permit CCAWS to turn an unfunded bill into a revenue source.

Because of mature technologies that recover the high value of the energetics, TOW and Chaparral can now be demilitarized at a cost significantly less than OB/OD. The total cost to demil the TOW inventory is estimated at less than $24 million, with a significant portion contributed by industrial investments. These technologies have been sponsored by the Joint Ordnance Commanders Group and managed by James Q. Wheeler, Defense Ammunition Center (DAC). The recycling technology for electronics, plastics, and precious metals at the Department of Energy (DOE) facility in Oak Ridge, TN, will be leveraged to increase recovery revenues. This path has great management and revenue potentials that can be developed economically in the near term for emerging requirements. Clearly, demil activities must be managed aggressively to maximize force modernization acquisitions.

Tactical missile demil presents a formidable task to manage within the next decade and must be executed enthusiastically as new acquisitions compete for resources. Currently, OB/OD is encumbered with environmental constraints. OB/OD will remain an alternate course of action that needs to be continued for unsafe munitions. However, environmentally safe methods that reclaim valuable materials are the smart way to execute demil of our aging missile stockpiles.

During the next 10 years, the shelf life of approximately 140,000 U.S.-owned TOW missiles will expire.

During FY98, the PEO, TM and the U.S. Army Aviation and Missile Command (AMCOM) Deputy for Systems Acquisition (DSA) jointly validated quantities for additional tactical missiles whose requirements are excluded.

Program Manager's Initiatives

In May 1998, the PM formally chartered an integrated product team (IPT) to formulate alternatives to minimize TOW demil costs. The IPT is comprised of rep-

resentatives from the PEO, TM; AMCOM's DSA Office; Missile Research, Development and Engineering Center; DAC; Industrial Operations Command (including Anniston Army Depot (ANAD)); and the U.S. Army Test and Evaluation Command's Redstone Technical Test Center. The IPT recommended four courses of action: minimize the quantity for demil, use the maturing R3 technologies, accelerate OB/OD for the legacy missiles, and continue technology base investments.

Discretionary initiatives are system unique. This process should begin at least 5 years prior to the mean shelf-life expiration of the missiles. To date, these discretionary initiatives have reduced the demil quantity 10 to 20 percent for TOW missiles. Increased training allotments were estimated and coordinated with the tactical user. There is strong support for additional live firings. Training needs, range availability, and support cost limit the quantity that can be effectively used. Alternative applications were considered and reductions were incorporated. Parts for reutilization were evaluated. FMS giveaways contributed to the reduced quantity by offering old missiles for training. After the requirements for the PM initiatives were identified, the residuals were candidates for demil.

This is a very complicated process because missiles typically are dispersed to numerous depots with mixed production lots. This approach was effective for TOW missiles; however, its use must be evaluated for other systems.

Proposed Path Forward

The demil activity resolves into two options: destruction by OB/OD or reclamation. Destruction by OB/OD totally consumes the inherent value and offers nothing to the cost-reduction objective. This approach contains numerous liabilities: subsequent real estate reclamation to ensure compliance with the Clean Air Act, Clean Water Act, Toxic Substance Control Act, etc. The cost to comply with these acts far exceeds the cost to execute OB/OD. Conversely, reclamation may not be economical.

R3 offers a revenue stream from the sale of piece parts and energy sources after processing for military and industrial applications. The most economic process is the reclamation of energetics from the propellant and warhead compositions. The 1.3-class of energetic sources typically contains nitroglycerine and nitrocellulose, which are low value and not economically viable for R3 considerations. Such can be found in Shillelagh, Dragon, Nike Hercules, etc., thus the need for OB/OD continues. The high-value 1.1-class of energetics (HMX/RDX) found in rocket motors and warheads economically warrant recovery. Nonrecurring investments are needed for TOW missiles to affect the economics of recycling. TOW and Chaparral missiles were selected because of their age, quantity, and high-recovery value potential.

R3 technologies are being optimized for worldwide applications. The metal industry has recycled steel and aluminum alloys for several decades. The automotive industry has been recycling to recoup production losses. DOE has established a pilot facility to recover precious metals and other products in the electronic industry, specifically to reclaim value of outdated personal computers (glass, metals, plastics, etc.). DOE has a long history of recovering contaminated metals. Economics will mandate R3 activities in other industries as technologies are developed.

A missile recycling center at ANAD is proposed and consists of four modules: disassembly, energetic reclamation, destruction, and processing. The missile will be delivered from the depot magazines to the disassembly module wherein the high-value energetics and subsystems will be removed, segregated, and packaged to meet secondary market requirements. The energetics will be shipped to the reclamation module. The warhead material (LX-14) will be separated, and the rocket motor propellant will be removed by dry machining or by ablation. These processes have been demonstrated as cost-effective, near-optimal techniques for recovery of energetics. A closed-loop, liquid ammonia-based process will be used to extract and separate energetic ingredients. The destruction module will be used to expend squibs, safe and arming devices, and unsafe rocket motors. The destruction module will contain an enclosed chamber so that unsafe warheads and explosive devices may be expended.

Recently, the reclamation technology for rocket motors and warheads was validated. There is minimal risk to upgrade the design of the pilot plant to an operational facility by using existing vessels and control equipment that exist in the chemical industry. The engineering challenge will be to meet the throughput rate of 75 to 80 missiles per day (15,000 per annum) for economic viability. The facility will be constructed with transportable modules and will accommodate emerging technologies. Technology is readily available for the TOW missile. *There is not a "silver bullet" for all tactical missiles.*

Conclusion

Nonrecurring investments (comparable to OB/OD) are needed for TOW missile demil. Such would preclude environmental liabilities. Revenue from the sale of recovered items will further reduce demil cost, potentially zero with industrial partnerships.

Changes to policy and legislation are needed to enhance the marketing and receipts from sales of materials. PMs need a readily available avenue to manage the revenue streams that will be derived from the sale of recovered products and precious metals.

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Helping The Civilian Community . . .

THE BIOLOGICAL WEAPONS IMPROVED RESPONSE PROGRAM

Dr. Mohamed Athher Mughal

Introduction

In March 1995, members of the Japanese cult Aum Shinrikyo attacked the Tokyo, Japan, subway system with sarin nerve agent. The incident captured international attention and sensitized world leaders to the threat of terrorist use of weapons of mass destruction. In response to this threat, the 104th Congress of the United States passed Public Law 104-201, *National Defense Authorization Act for Fiscal Year 1997*. This Act contained Title XIV—*Defense Against Weapons of Mass Destruction*, which provided for preparedness training against weapons of mass destruction for our Nation's first responders. Additionally, Section 1415 of Title XIV stated, "The Secretary of Defense shall develop and carry out a program for testing and improving the responses of Federal, State and local agencies to emergencies involving biological weapons and related materials and emergencies involving chemical weapons and related materials." As a result of this legislation and in support of DOD, the U.S. Army Soldier and Biological Chemical Command (SBCCOM) developed a Biological Weapons (BW) Improved Response Program (IRP).

The BW IRP is a multiyear analytical program designed to identify and demonstrate the best practical approaches to improve the overall preparedness of the United States to respond to domestic acts of terrorism involving BW or BW-related materials. This article describes program design, major products, and future plans of the BW IRP.

Characteristics Of Domestic Bioterrorism

The overriding consequence of a large-scale unannounced bioterrorist attack will be the rapid occurrence of a large number of medical casualties. Response systems must provide appropriate medical treatments and services. However, the full spectrum of potential consequences is much broader than medical casualties.

A well-conducted bioterrorist attack will strain our Nation's public health surveillance systems. It will also require responders to make quick, accurate medical diagnoses and disease identifications. By definition, a bioterrorist event is a criminal act that will require a complex criminal investigation. Depending on the agent used in an attack, such an incident could also result in residual environmental hazards that would require mitigation. Considering the potential magnitude of casualties, a significant portion of a metropolitan area's population may have to be medically managed and controlled. The aforementioned medical treatment, criminal investigation, environmental hazard mitigation, and population control activities will require a coordinated and integrated command and control effort extending across federal, state, and local jurisdictions. In short, the full spectrum of consequences that must be managed encompasses multiple professional disciplines and functional areas of responsibility spanning three levels of government.

Designing The BW IRP

The above considerations influenced the makeup of the BW IRP Team in fundamental ways. Because the problems inherent in a terrorist attack are multifaceted, we needed a multidisciplined team that included participants from federal, state, and local emergency response organizations. Recognizing the technical complexities surrounding biological weapons and terrorism, we also included experts in the offensive and defensive aspects of biological weapons. The final team consisted of more than 60 federal, state, and local responders as well as technical experts from 9 states. The BW IRP Team included participants from federal, state, and local agencies. In fact, 8 federal agencies, 6 Department of Energy national laboratories, and 11 DOD organizations were represented.

Having assembled a strong team, SBCCOM began to define broad parameters of the overall process for the BW IRP. The process first had to provide a forum to educate and inform the entire interdisciplinary and multiagency team on the offensive and defensive aspects of biological weapons and bioterrorism. Second, the process had to yield an initial set of integrated response activities designed to manage and mitigate the full spectrum of consequences that would emerge from a large-scale domestic bioterrorist event.

The BW IRP Process

The BW IRP process was designed around five 3-day technical workshops. Each day of each of the five workshops was similar in structure, but different in content.

Day 1 of each workshop consisted of a series of 1-hour tutorials on preselected topics such as the physics of aerosol dispersion, pathogenic microbiology of BW agents, biodetection, medical prevention and intervention, and decontamination of and physical protection against BW agents. Although the topics remained the same, the depth and complexity of the tutorials increased as the team progressed through each of the five workshops.

Day 2 of each workshop began with the presentation of a selected BW terrorist attack scenario. From workshop 1 through workshop 5, the respective terrorist attack scenarios increased in scale from an attack on a single building to an attack on an entire metropolitan area. After reviewing each scenario, workshop participants identified a series of specific response activities designed to mitigate the emerging consequences of the given bioterrorist attack scenario.

On Day 3 of each workshop, the team reviewed and integrated the complete set of response activities. The team also analyzed the integrated activities to

identify response shortfalls and possible response improvements. Throughout the reviews, the team took a "bottom up" approach and *let the problem drive the solution.*

BW IRP Products

The BW IRP Team identified a myriad of response activities spanning multiple functional areas. To be useful and understandable, these activities needed to be organized into a logical and integrated response system. Thus, the team formulated a generic bioresponse template (see chart below) that embodied the concepts and work breakdown structure a city needed to respond effectively to a bioterrorist event. This template serves as a useful starting point for cities and states in preparing their own local plans to respond to a bioterrorist attack.

Future Plans

SBCCOM plans to validate and improve selected components of the response template through tests and exercises. In addition, SBCCOM is partnering with the Centers for Disease Control and Prevention in developing and testing an appropriate public health surveillance system. The First Army's Joint Regional Medical Planning Office is assisting SBCCOM's team in planning and executing a functional test of the template's casualty care function. SBCCOM will conduct a follow-on workshop with the FBI and local law enforcement representatives to identify and define the nuances of criminal investigation for a bioterrorist incident.

Additionally, the response template as a whole will be evaluated in three different cities. The cities will be geographically dispersed and of varying populations. These evaluations will provide feedback on the general applicability of the template and will indicate how it can be adapted to specific cities in different localities and with different populations.

Finally, we continue to assess response improvement concepts. Specifically, we are working to develop chemical and biological building protection measures, biodecontamination techniques and protocols, subway biosurveillance technologies, emergency response management software, and biocasualty projection methods to assist civilian emergency managers in assessing the consequences of a bioterrorist attack.

Conclusions

In a short period of time, the BW IRP has begun to provide civilian emergency managers and first responders a logical conceptual framework to improve overall preparedness for responding to domestic bioterrorism. Through follow-on activities of the BW IRP, these initial response concepts will be both validated and improved. The concepts will also be extrapolated and applied to the requirements of military installation responders and response units.

In addition to providing these tangible benefits to our Nation's civilian communities, the BW IRP highlights another important fact: the Army's research and development centers are a valuable national resource that can provide broad-based benefits beyond the military community. The successes of the BW IRP specifically underscore how Army scientists and engineers can effectively partner with federal agencies as diverse as the FBI, the Federal Emergency Management Agency, the Department of Health and Human Services, and the U.S. Department of Agriculture. Indeed, through the BW IRP, SBCCOM engineers and scientists have worked side by side with state and local representatives in functional specialties spanning law enforcement, hazardous spill management, firefighting, and emergency medical services. Considering the organizational and practical benefits of such partnerships, the SBCCOM feels privileged to continue working on this critical national effort.

BW/IRP RESPONSE TEMPLATE OUTLINE AND WORK BREAKDOWN STRUCTURE

2.1	Public Health Surveillance
2.2	Medical Diagnosis
2.3	Epidemiological Investigation
2.4	Mass Prophylaxis
2.5	Criminal Investigation
2.6	Residual Hazard Assessment and Mitigation
2.7	Control Affected Area/Population
2.8	Care of Presented Casualties and Worried Well
2.9	Fatality Management
2.10	Command and Control
2.11	Resource and Logistical Support
2.12	Continuity of Infrastructure
2.13	Family Support Services

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ALTERNATIVE TECHNOLOGIES AND APPROACHES FOR CHEMICAL DEMILITARIZATION

LTC Joseph E. Pecoraro

Introduction

The U.S. Army has more than 75 years of chemical weapons disposal experience. Industrial-scale agent munitions were destroyed using the Chemical Agent Munitions Disposal System at Tooele, UT, which was constructed to test incineration and neutralization methods. During testing conducted from 1979 to 1986, more than 83 metric tons of chemical agents were safely destroyed. As a result of this testing, the Army selected incineration as the best method of disposal. This decision was endorsed by the National Academy of Sciences' National Research Council (NRC) in 1984. Legislation passed in 1985 directed the destruction of the stockpile and creation of the management organization, the Program Manager for Chemical Demilitarization (PMCD), to oversee that process.

By 1992, public concern about incineration prompted Congress to task the Army to test alternative technologies for chemical weapons disposal. Around the same time, PMCD asked the NRC to reexamine the potential for alternatives to incineration as the treatment to destroy chemical weapons materiel. In 1994, the NRC recommended neutralization for sites that store only bulk agent in steel containers. As a result of the NRC's findings, as well as the Army's independent analyses, the Alternative Technologies and Approaches (ATA) Project was created to further investigate neutralization processes for the bulk agent storage sites.

An ATA team initiated an aggressive research, development, testing, and evaluation program. This program examined alternatives for the destruction of bulk HD (blister agent mustard) stored at the Edgewood Chemical Activity in Maryland, and nerve agent VX stored at the Newport Chemical Depot in Indiana. Teaming was essential to program success. The ATA team included Army officials, citizen groups, Citizens' Advisory Commissions (CACs), state agencies, and contractors.

The ATA Project is unique because it is not driven by a potential national threat or based on an Army Training and Doctrine Command requirement as are most Army research and development (R&D) programs. The project is driven by public concerns and a strict disposal timeline mandated by the Chemical Weapons Convention. The demonstrated ability to keep such a politically sensitive project on the fast track makes it an interesting case study for the R&D community.

Testing Program

The ATA Project could not have moved forward without an intensive and accelerated testing effort to validate the effectiveness of the technologies. More important, the project had to ensure that the selected technologies could be engineered to full-scale pilot plants. This effort required a dedicated team of government and contractor personnel.

The following were among the many tests conducted:

- Ton container (TC) evaluations;
- TC cleanouts;
- Laboratory and bench-scale neutralization, biodegradation, and supercritical water oxidation (SCWO); and
- Effluent toxicity.

An essential part of the testing program involved ton container characterization and decontamination. The HD at Edgewood and the VX at Newport are stored in metal containers called TCs. There are 1,817 TCs (1,623 tons of HD) at Edgewood and 1,690 TCs (1,269 tons of VX) at Newport. To assess the composition of the agent in the TCs, the containers and their contents were analyzed. At Edgewood, 300 TCs were nondestructively evaluated to determine agent fill levels and the presence of hardened agent encrustations called "heels." Another 27 TCs were intrusively sampled to determine agent purity, detect impurities, and examine physical properties. At Newport, 100 containers were checked, followed by the intrusive sampling of 27 of those same containers.

Once the state of the container interiors and the agent inside were established, the Army was able to establish the ability to decontaminate the containers to a safe level for shipment to a metal recycling facility. Tests demonstrated that high-pressure water (2,500 pounds per square inch) at 90 degrees Celsius could successfully decontaminate the containers. This process will be incorporated into the facilities at both Edgewood and Newport.

Another essential part of the testing program involved laboratory-level tests that initially were used to establish the effectiveness of the selected neutralization processes. Scale-up was tested by reaction in both a 2- and 12-liter Mettler Reaction Calorimeter and a 114-liter vessel located in a chamber fitted for testing chemical agents. For each system, the parameters of the neutralization reaction could be identified and optimized for the next level and reaction safety verified. In total, 87 agent tests were conducted on the 2-liter Mettler and 23 on the 12-liter Mettler.

Finally, post-treatment tests were conducted. The bench tests examined the effectiveness of the sewage sludge process for biodegradation of the HD hydrolysate in a series of bioreactors that were operated 24-hours a day, 7 days a week, for 10 months. Care was taken to ensure that every test in the program was planned and conducted safely.

In addition to tests with neutralization, the ATA team turned to private industry to ensure that the most recent technological developments were considered during the concept exploration phase.

In August 1995, the ATA team solicited concept design packages via the *Commerce Business Daily*. The team requested that these packages address operations at the plant level and be capable of meeting the then congressionally mandated destruction deadline of Dec. 31, 2004. Twenty-three proposals were received and evaluated, and three were selected for further consideration. The selected firms were required to demonstrate the effectiveness of their technologies on actual chemical agents at Army-approved facilities.

The three selected firms provided their design packages to the NRC, the Army Materiel Systems Analysis Activity (AMSAA), and a panel of subject matter experts from government and industry known as the Core Evaluation Team (CET). The NRC, AMSAA, and CET were then asked to provide independent assessments of the commercial technologies as well as neutralization for Edgewood and Newport.

Each evaluation team developed its own criteria independently and then coordinated the criteria prior to application. The ATA team worked with the NRC and the Maryland and Indiana CACs to develop the evaluation criteria. In addition, Mitretek Systems was asked to perform an independent assessment of the safety, health, and environmental risks of the proposed alternatives to aid in the evaluation process.

The ATA team considered all the evaluation reports and the recommendations of the CACs and the public before recommending that neutralization and follow-on treatments be used for the pilot plant disposal programs at Edgewood and Newport. As a result of the thorough groundwork performed by the ATA team, on Jan. 17, 1997, the Under Secretary of Defense for Acquisition and Technology gave concurrent approval for Milestones I and II. In addition, the Army was authorized to proceed directly into the engineering and manufacturing development phases for full-scale pilot facilities at the storage sites.

The current program calls for HD to be neutralized with hot water and its hydrolysate biodegraded with activated sewage sludge. VX will be neutralized in a hot sodium-hydroxide solution and its hydrolysate treated with supercritical water oxidation to reduce it to simple compounds that can be disposed of easily.

Environmental Compliance And Public Involvement

With Milestones I and II successfully completed and the Office of the Secretary of Defense's authorization to proceed with pilot plant construction, environmental permits became a prominent issue. In concert with the Environmental and Monitoring Office, the ATA team had to prepare Environmental Impact Statements (EISs) as well as submit Resource Conservation Recovery Act, Clean Air Act, and Clean Water Act permits. The permit process and the EIS also mandated a round of public forums in which the public and interested groups had the opportunity to give input into the proposed alternative technologies.

The ATA team had a good start in dealing with the environmental issues and agencies because the public was involved in the decisionmaking process from the start of the program in August 1994, the concept formulation phase. This was enhanced by the creation of Working Integrated Product Teams (WIPTs). WIPTs are comprised of state regulators, citizens, and public interest groups; chemical activity staff personnel; representatives from the Environmental Protection Agency (EPA) and the Corps of Engineers; and ATA technical staff. The WIPTs were developed to:

- Create a forum for open and honest discussion,
- Eliminate confusion and foster cooperative information exchange,
- Rapidly identify and resolve problems,
- Provide timely feedback,
- Provide better quality applications and response to comments,
- Reduce the number of interactions and develop products concurrently, and
- Facilitate permits without influencing the independence and objectivity of regulators.

This working group and the intended management structure for the project are modeled after private industry's method of horizontal management.

A level of trust and mutual support was developed as a result of the formation of the WIPTs. The ATA team provided early drafts of its permit applications and EIS for review by the regulatory officials, who in turn provided valuable comments and recommendations. This process saved considerable time and allowed the environmental compliance actions to keep pace with technological developments.

Conclusion

The ATA team has accomplished a tremendous amount of work in an exceedingly short time. In October 1998, Bechtel National Inc. was awarded the Aberdeen Chemical Agent Disposal Facility systems contract. In February 1999, the Maryland Department of Environment and the EPA issued the necessary environmental permits for the pilot testing of neutralization and biotreatment technologies. Also in February 1999, Parsons Infrastructure and Technology Group Inc. was awarded the systems contract for the Newport disposal facility.

A number of challenges, however, still remain: reinforce the blending of the system contractors into the integrated ATA team, identifying uncertainties that exist and determining ways to manage them, and finalizing plant designs. To meet these challenges, technical integration meetings will be held with all involved personnel to coordinate actions and address issues as they arise. The ATA team will continue encouraging teamwork and partnerships, technical expertise, dedication, intensive management, and an unwavering focus on the ultimate objective—working together to safely destroy the chemical agent stockpile.

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Corpus Christi Army Depot . . .

ROTARY WING AIRCRAFT SUSTAINMENT

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Introduction

Declining budgets have increased DOD's emphasis on producing higher quality products with reduced cycle time at a lower cost. Competition with industry, downsizing, base closures, privatization, changing environmental laws, and the use of current weapon systems beyond their intended life cycle are significantly changing the way depots do business.

The Corpus Christi Army Depot's (CCAD's) Industrial Engineering Department has developed a multiyear applied research, development, test, and evaluation program for rotary-wing aircraft sustainment to reduce operation and maintenance costs. CCAD, which provides remanufacturing and logistics support for all Army and some Navy, Air Force, and Marine Corps helicopter systems, is using manufacturing technology (MANTECH); reliability, maintainability, and sustainability; and the National Defense Center for Environmental Excellence funds to deliver better products, faster and cheaper. CCAD services helicopter blades, engines, transmissions, gearboxes, avionics, hydraulics, and airframes. This article provides an overview of current CCAD projects including expert statistical process control (SPC) for job shop and sustainment operations, computer-matrixed thermal-curing blankets for main rotor blade composite repair, universal static balance stands for main rotor blades, and beneficial stress induction in rotary-wing flight-critical components. (For more information, see *Army RD&A* magazine, September-October 1997, Page 35).

Statistical Process Control

A new expert SPC system developed for the CCAD machine shop operations addresses the unique technical challenge of statistically controlling processes with small unit sample sizes and high-product mix. Both ISO 9000 and parts visibility require data traceability for both part and process data. ISO 9000 refers to a commercial standard established by the International Organization for Standardization that reflects the shift away from military specifications. To analyze data for problem resolution, out-of-control analysis, and variance component identification, both part and process traceability capabilities were implemented. This analysis is facilitated by using data stored in a distributed architecture built around a system-based relational database structure. The system supports both attribute and variable charts, Pareto analysis, and original equipment manufacturer (OEM) specifications superimposed on the standard control limits. Pre-control, short-run, and trend analysis are also supported.

This is the first time that expert SPC has been applied on a distributed online basis throughout all depot sustainment operations. The new applicability in the job shop and sustainment operations sets this effort apart from any other past SPC sustainment effort and offers a choice for other remanufacturers. The project is being distributed to other operations at the depot where repeatable measurement and data logkeeping can be automated to reduce cost.

Main Rotor Composite Repair

Main rotor blades are one of the most critical elements for flight performance, and the composite repair techniques employed by the depot require high levels of precision. Removal of critical leading-edge subassemblies requires rebonding part of the blade, and the heat applied during that process must only cure the damaged repair area while not exceeding the thermal limits of the remaining areas. Controlling temperatures on a length that exceeds 24 feet is no easy task. If the nondamaged area is overheated, then a blade is suspect because the original cured adhesive systems may have been compromised.

To eliminate this potential overheating concern during main rotor composite repair, CCAD developed, demonstrated, and placed into depot remanufacturing production a thermal curing blanket that can maintain a temperature of 250 degrees Fahrenheit, plus or minus 5 degrees, over a 24-foot-long bonding surface. This is a reliable, durable, and repeatable method by which main rotor leading edge de-icing mat sheath assemblies (one of the depot's most difficult advanced composite repairs) could be replaced and rebonded. By using control feedback and closer heat zoning, this effort demonstrates control of localized heating over a long span to plus or minus 5 degrees. This project, completed in December 1998, provides technology that can be horizontally applied to any repair dealing with thermal curing using heat blankets.

Universal Static Balance Stand

CCAD and its contractors, General Research Corp. and AVION, have developed a digital method to static balance several different blade models and types on one fixture at a low cost for both depot and field operations. This replaces currently used large hard tooling for each helicopter model and type in the depot environment. Once implemented, this single flexible fixture will replace 10 existing customized depot fixtures and will enable users to statically balance any type of main rotor blade with one fixture.

Currently, each rotor blade type has its own static balance fixture even though the calculated span-wise center of gravity and adjustment is similar. Some fixtures provide the chord-wise center of gravity and overall blade weight (all other blades are weighed later in the process). A teetering system is used to establish a rough range static balance, leaving movement of tip end weights to operator discretion. Fixture variability causes great variability on the dynamic balancer (whirl tower) later in the process. Greater variability on the whirl tower slows operations and makes proper blade tracking more difficult to achieve.

This prototype static balance fixture will support all DOD main rotor blades and provide tighter blade adjustment tolerances within the existing range on the span-wise center of gravity, chord-wise center of gravity, and overall blade weight. Projected supported blade types include the CH-47D Chinook (fore and aft blades), H-60 Blackhawk and Seahawk, AH-64 Apache, AH-1S Cobra, AH-1W Super Cobra, UH-1 Huey, OH-58D Kiowa Warrior, CH-53E Sea Stallion, CH-46, CH-53D, H-2, and H-3.

nected to three specifically placed load cells to calculate the span-wise and chord-wise centers of gravity and the overall blade weight. Correlation tests with OEMs are ongoing to establish a relationship between the static and the desired dynamic chord-wise centers of gravity. This fixture was initially developed for the field to reduce depot-level blade overhaul. This development will save thousands of dollars in the field and will help the depot maximize vital production shop floor space.

Critical Component Stress Induction

CCAD receives a variety of unique, geometrically complex flight safety parts that require fatigue life enhancement (shot peening). CCAD has started an initiative to increase productivity, decrease cycle time, and improve consistency in organic peening capabilities. Texas A&M University was contracted to determine "as-is" and "to-be" workload and cost profiles, current practices, resources usage, and capabilities.

CCAD maintains a unique position within the wider spectrum of peening applications. Peening requirements focus on helicopter components and closely resemble a job shop operation. Even within a given "part family," a particular component might require significantly different process scenarios. For example, a particular part may have 20 different peenable surfaces, but actual surface conditions may necessitate treating only 5. This wide variation results in different peening profiles, masking requirements, and process procedures. These characteristics are unique to depot operations and pose formidable problems in a transition from manual, labor-intensive peening to highly automated, computer-controlled operations.

A flexible, highly automated, computer-controlled shot peening center was proposed and designed for CCAD implementation. Capabilities include automated recipe downloading, charging, and tool positioning; automated/semiautomated masking; part orientation; and setup. High-precision robots provide accuracy and flexibility to peen a wide variety of part geometries. This project will consolidate all peening specifications, surface inspection procedures, setup and nozzle parameters, and real-time audio and visual aids in a relational database structure. This database will become the "standards" clearinghouse for all depot maintenance work requirements, OEM, and CCAD specification updates and changes. This system uses intranet-based technology, and information-gathering activities have been reduced by an order of magnitude.

Expert Maintenance System

Two critical sequences in the remanufacture of rotary-wing aircraft are the rotor blade remanufacturing operations and its follow-on dynamic balance (whirl tower). There are "bottleneck" operations on the critical path, so maximum availability is required. CCAD, through a contract with Texas A&M University, has installed a predictive and preventive maintenance expert system (PPMES) that captures live sensor data; logs and transforms analog data into digital forms using new "wavelet theory"; performs diagnostic and predictive tests to project failure potential; schedules maintenance; and organizes data for reliability, availability, and maintainability analysis and the establishment of spares management policies. The system works with existing legacy systems. The data display client is designed for maximum flexibility, compatibility, and expansion using standard intranet Web browser "push" technologies.

PPMES will minimize breakdowns and defects, maximize equipment operation rates, reduce life-cycle costs, extend equipment life, improve troubleshooting, and minimize spare and replacement parts inventory. As a consequence, labor and machine productivity will increase for selected mission-critical equipment. The PPMES automates equipment usage tracking and monitors key sources of deterioration. It gathers data and provides statistical analysis capabilities that categorize, summarize, and analyze equipment status and availability. Warnings are sent to machine operators for at-risk operations.

Conclusion

With base closures, privatization, and declining Defense budgets, affordable sustainment of legacy weapon systems is more important than ever, especially when they are used beyond intended design life. To address this new Army After Next reality, CCAD has implemented a multiyear research, development, test, and evaluation effort to capture technologies for operational cost savings. Our challenge is to address the nontraditional, complex remanufacturing production issues that are the Army's high-cost drivers.

ELDON V. ANDERSON was a Senior Industrial Engineer managing the MANTECH Program at the Corpus Christi Army Depot at the time this article was written. He is now a Branch Chief in the Engineering Resource Management Division at the 98th Area Support Group, Wuerzburg, Germany. He received his B.S.E.E. from the University of Idaho.

DR. JOHN F. AYALA, P.E., was a Senior Industrial Engineer managing the MANTECH Program at the Corpus Christi Army Depot and had just completed a developmental assignment in the then Office of the Assistant Secretary of the Army for Research, Development and Acquisition (now the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology) at the time this article was written. He is now a Logistics Management Specialist and the Combat Developer's Representative at the U.S. Army Medical Department Center and School at Fort Sam Houston, TX. He received his doctorate in engineering and his MSIE from Texas A&M University, and his B.S.E.E. from St. Mary's in San Antonio, TX.

T. ELAINE LAMBERT is a Physical Scientist Administrator in the Chemical Material Process Branch at the Corpus Christi Army Depot. She received her BSMET from the New Mexico Institute of Mining and Technology.

RODNEY D. MAYO, P.E., is a Senior Industrial Engineer in the Industrial Engineering Division and is a Project Manager for several MANTECH projects at Corpus Christi Army Depot. He received his BSMET from the University of Texas at El Paso.

DR. DON T. PHILLIPS, P.E., is the Chevron Corp. Professor of Industrial Engineering, the Engineering Program Manager for Life Cycle Engineering Operations Management, and the Director of the Texas Center of Excellence in Manufacturing Systems at Texas A&M University, College Station, TX. He received his Ph.D. in industrial engineering from the University of Arkansas, his MSIE from the University of Arkansas, and his BSIE from Lamar State College of Technology in Beaumont, TX.

From The Acquisition Reform Office . . .

Guided Multiple Launch Rocket System: A New Approach To Systems Acquisition

The Guided Multiple Launch Rocket System (GMLRS) Program demonstrates some of the concepts of the new approach to systems acquisition (see "DOD Hosts Live Satellite Broadcast" beginning on this page). The program makes extensive use of commercial practices, processes, and technologies to reduce cycle time and total ownership costs. Other concepts incorporated by the GMRLS Program are as follows: modification instead of new development, leveraging legacy programs, using mature technology, using integrated product teams (IPTs), innovative partnering, innovative contract/incentives, best-value competition, shorter cycle time, interoperability, and lower life-cycle costs.

The U.S. Army Aviation and Missile Command's (AMCOM's) Aviation Center and the Program Executive Office (PEO), Tactical Missiles, used the first international Alpha contracting concept for the award of the GMLRS. The latest GMLRS contract presents a different perspective on partnering with four international co-developers who have been and will continue to be engaged in the day-to-day activity of awarding and administering the contract. The Alpha contracting process used IPTs in the development and evaluation of the proposal. The European partners were participants along with the GMLRS Program Management Office (PMO), the Defense Contract Management Command (DCMC), the Defense Contract Audit Agency, and the contractor. This process played a major role in reducing administrative lead-time (ALT).

GMLRS is a product improvement, incorporating a global positioning system guidance package into the rockets to improve accuracy. The feasibility of the concept was demonstrated under the advanced concept technology demonstration contract when a rocket flew in excess of 40 kilometers and landed within 1.4 meters of the target during a recent flight test. The current contract with Lockheed Martin/Vought Systems is for engineering, manufacturing, and development and could have been awarded within 7 months ALT except for time spent waiting for a final memorandum of understanding between the governments. It is a 4-year, $121-million effort. The United States is committed to fund 50 percent of the program, and our partners will fund 12.5 percent each.

The multinational partners have made business process decisions that no arbitrary work shares among countries would be invoked but that subcontracts would be awarded using competitive best-value techniques.

Early in the contracting process, a method was needed to enhance communication among all parties. The result was a form of paperless contracting. In cooperation with the PEO, PMO, DCMC, and Lockheed Martin/Vought Systems, the AMCOM Acquisition Center devised a way to convert the contract documents into a format suitable for e-mail transmission. The simultaneous review of terms and conditions by all parties significantly shortened the coordination cycle. Contract management and administration will also be paperless with the contract, modifications, minutes of the IPTs, and progress reports available electronically for review by all the partners.

The contract uses an innovative award fee structure to motivate the contractor. The allocation of the fee is not time-based as in the traditional award fee contract but is milestone-based and allocated to accomplishing the following major aspects of the program: preliminary design review, critical design review, production qualification tests, and the product definition data package. An IPT approach will be used to evaluate the contractor's efforts. Each IPT, including contractor personnel, PMO, and other participants, will make recommendations with rapid feedback to the contractor.

The joint development effort will lead to greater interoperability with our allies and will be less costly to the United States because of cost sharing. In addition, lower life-cycle costs will result from the increased accuracy, which will require fewer rockets for the same or better effects on target.

For additional information on the GMLRS Program, contact MAJ Robert E. Leonard at (256) 876-4588 or e-mail: ***leonard-re@redstone.army.mil.***

DOD Hosts Live Satellite Broadcast *Putting It All Together: A New Approach To Systems Acquisition*

In a Sept. 23, 1999, broadcast, Under Secretary of Defense for Acquisition, Technology and Logistics Dr. Jacques S. Gansler joined representatives from DOD and private industry to discuss how acquisition reform efforts are affecting the front end of Defense systems acquisition. This was the latest in a series of broadcasts hosted by the Office of the Deputy Under Secretary of Defense for Acquisition Reform to improve communication among DOD policymakers, program managers, contracting officers, and others involved in systems acquisition. The powerful live satellite broadcast with Web simulcast was designed specifically for the systems acquisition workforce.

Gansler discussed a new model for systems acquisition using flexible requirements, incremental development, and cost as a design driver. A distinguished panel representing the Joint Chiefs of Staff and private industry used real-world case studies to show how existing reform efforts, when applied together to each acquisition system, produce a single acquisition strategy, the new approach to systems acquisition. The concepts embodied in this new approach—which promote the use of commercial practices, processes, and technologies to reduce cycle time and total ownership costs—exemplify the ideal features of the acquisition process for the next millennium. The key components of the new approach are as follows:

- Requirements/Technology Integration,
- Flexible Requirements/Spiral Development,
- Mature Technology,
- Interoperability/Open Systems,
- Integrated Test and Evaluation,
- Simulation Based Acquisition,
- Logistics Transformation/Built-in Reliability,
- Cost as a Design Driver, and
- Full Funding.

ACQUISITION REFORM

These concepts are helping DOD achieve systems acquisition better, faster, and cheaper by *putting it all together.*

For additional information regarding these broadcasts, contact Melissa Pittard in the Acquisition Reform Office at (703) 681-7571 or e-mail ***pittardm@sarda.army.mil.***

Section 912
Product Support Reengineering Report

In July 1999, Dr. Jacques S. Gansler, Under Secretary of Defense for Acquisition, Technology and Logistics, signed the Section 912 *Product Support Reengineering Report.* It provides overarching strategy for implementation of new business practices for transforming logistics for the 21st century. Total Ownership Cost Reduction pilots are the "testbeds" for trying some of these changes. The following is a partial excerpt from Gansler's foreword to the report.

Foreword

This report on Product Support for the 21st Century charts some of the important next steps of continued acquisition and logistics reform. It identifies how the Department of Defense (DoD) will capitalize and expand on best practices - commercial and government - to transform weapon system support processes to meet the urgent operational needs of our warfighters. It emphasizes competition as a continuous life-cycle ingredient to provide best-value support and mandates continuous technology refreshment as an effective method to lower weapon system total ownership costs while at the same time satisfying the warfighters' operational and readiness requirements.

This document is more than a report. It is an implementation strategy, built on the Section 912(c) Report submitted to Congress by [Defense] Secretary Cohen in April 1998. That report, Actions to Accelerate the Movement to the New Workforce Vision, responded to the requirements in Section 912(c) of the Fiscal Year 1998 National Defense Authorization Act.

This product support reengineering implementation strategy is a critical part of our logistics transformation to achieve Joint Vision 2010. The strategies, implementation elements, and outcome objectives that are fundamental to product support reengineering coincide with the logistics transformation objectives of operational agility, improved customer service, and integrated logistics chains. The product support reengineering plans build on the promising initiatives in the Military Departments and Defense Logistics Agency and accelerate the adoption of best practices.

I will continue to focus my attention and energy on five areas: pilot programs, financial processes and systems, information systems modernization and security, competitive base development, and warfighter-customer interfaces. I look forward to working the DoD Components, the Congress, and industry as we use product support reengineering as a primary tool for meeting the customer requirements of our warfighters.

The point of contact for this article is Betsy McChesney at (703) 604-7155.

For additional information on acquisition reform, contact Monti Jaggers in the Acquisition Reform Office at (703) 681-7571, e-mail: ***jaggersm@sarda.army.mil.***

Walker Chosen As AAESA Director

Karen A. Walker, former Acting Director of the Army Acquisition Executive Support Agency (AAESA) and Chief of its Acquisition Structures Division, was recently selected as AAESA Director.

Backed by more than 25 years of federal service, Walker is a member of the Army Acquisition Corps (AAC) and has extensive experience in Army materiel acquisition, the project management process, and acquisition career management. Included among her earlier key assignments were Acting Deputy Director, Acquisition Career Management Office (ACMO), Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology; Acquisition Proponency Specialist, ACMO; Director of Communications, AAC Reengineering Team; and Project Management Specialist, Office of the Director, ACMO.

Walker holds a B.S. degree in business administration from Strayer College and is currently working on an M.S. degree in management from the University of Maryland. In addition, she is a graduate of the Excellence in Government Fellows Program and the Defense Systems Management College Advanced Program Management Course, and is Level III certified in program management.

CONFERENCES

FED LAB 2000

The Fourth Annual Army Research Laboratory (ARL) Federated Laboratory Symposium (FED LAB 2000) will be held Mar. 21-23, 2000, at The Inn and Conference Center, University of Maryland University College, College Park, MD. The symposium is held annually to provide a forum for presenting research results from the three consortia that comprise the ARL Federated Laboratory. FED LAB 2000 will consist of three concurrent conferences: advanced sensors, advanced displays and interactive displays, and telecommunications/ information distribution. The format will include presentation of research papers and interactive poster sessions.

To receive a registration packet and agenda when available, please fax or e-mail your name, title, organization, street address, city, state, zip code, commercial phone and fax numbers, and e-mail address to (757) 357-5108 (if by fax) or **caktmc@aol.com** (if by e-mail). If you have any additional questions, please call (757) 357-4011.

Quantum Jump: A survival guide for the new Renaissance

By W.R. Clement, Toronto: Insomniac Press, 1998

Reviewed by Dr. Robert J. Bunker, Fellow, Institute of Land Warfare, Association of the United States Army.

Clement's central argument in this important work is that a higher level of abstraction is required for individuals and their societal groupings to survive during the second Renaissance now taking place. Of necessity, such an argument requires a discussion of the time-space continuum and Western post-medieval views of dimensionality. The terms hyperspace (geometric), cyberspace (informational), and N-space are used interchangeably to discuss the higher dimension that has emerged. The works of Planck, Einstein, Heisenberg, Schrodinger, and Dirac are drawn upon in the text, and the author has a good working knowledge of the scientific literature.

While the book has a political science and economic focus and utilizes discussions of artistic perspective in support of its arguments, it has profound implications for research, development, and acquisition professionals. It supports the contention of some military scholars that a more advanced definition of battlespace, beyond that utilized in *Joint Vision 2010*, is critical to future Army warfighting needs. The important nature of this theoretical requirement is underscored in an early passage on Page 49 of this work:

> *Historically, societies that have failed to accommodate emergent world-views have lost access to the betterments of growth and improved economic and social benefits congruent with their time in history. In fact, their access to the economic benefits decreased as they slipped from the global mainstream. The services they were able to deliver to their citizens deteriorated and their influence on world issues became irrelevant. Societies which do not embrace new-world views do not usually survive. Some slip back to barbarism. Others are subsumed into more adaptive cultures whose intellectual evolution has been more successful.*

The book is divided into five parts. The first part discusses the beginning of the hyperspace era and its interrelationship to the developing new world order. The second part focuses on the fault lines developing in the new world order. A very interesting section concerning Islam's dysfunctional relationship to cyberspace should be noted in this part of the book. It is reminiscent of LTC Ralph Peters' (USA, Ret.) discussion of the warning signs of "noncompetitive states" in his work *Fighting for the Future*. The third part explores life in cyberspace and the increasing value of tangential thought (e.g., nonlinear intuitive problem solving that utilizes inadequate information and conventionally unobserved functional relationships). Implications for human culture and government are also covered along with the recognition that the nation-state is entering its twilight. This suggests that as nonstate actors increase in power relative to the nation-state, they could become a direct security concern; however, this line of thought was not addressed by Clement.

The fourth part discusses survival strategies for contending with a multidimensional world. The information age is envisioned as the first age of the cyberspace era and will require a new form of literacy. Attempts at cyberspace censorship are expected to fail. They are viewed as a natural reaction from those in positions of power attempting to protect their vested economic interest and social status. This is much like what took place with the church and the Inquisition during the last great quantum jump in human abstraction.

The fifth part provides an epilogue. It suggests that new questions need to be asked to create an epistemology that allows us to function in the cyberspace era. This need is in variance to conventional wisdom that doesn't even acknowledge the existence of such questions. In addition to historical examples of what happened to various European nations during the last quantum jump, the author warns against suppressing the emerging new knowledge.

This important work includes an index but suffers from lack of a bibliography. Even with this slight shortcoming, it should be considered standard reading for those in pursuit of promoting future Army warfighting capabilities.

Project Management Body of Knowledge Questions & Answers

Project Management Institute (PMI), 1997

Reviewed by LTC Kenneth H. Rose (USA, Ret.), Tidewater-Richmond Area Manager for Waste Policy Institute in Hampton, VA, and a former member of the Army Acquisition Corps.

A challenge facing many project managers is not just to develop skill in established procedures, but to gain deeper understanding of the generally accepted knowledge and practices of the project management profession. *Project Management Body of Knowledge Questions & Answers* (PMBOK Q&A) is a handy booklet that facilitates achieving that goal.

The booklet includes 170 questions and answers that address the nine subject areas of PMI's *A Guide to the Project Management Body of Knowledge*, reviewed in the September-October 1998 issue of *Army RD&A*. The questions were developed by a team of project management professionals from PMI's service corps. Questions are grouped in sections by subject area. They are presented in a variety of formats, which keeps the approach fresh and the readers on their toes.

Answers stand apart in a separate section so the reader will not be tempted to glance ahead and short-circuit the benefits of thoughtful reflection. Each answer provides the correct response, a reference to the page and paragraph in the *PMBOK Guide* that contains the foundation information, and a brief discussion of the answer. In some cases, the reference points to a textbook that provides the basis for the question and answer in lieu of the *PMBOK Guide*. The completeness of the answer element makes the booklet a valuable reference for learning or review.

At 3-1/2 by 5-1/2 inches, the spiral-bound booklet fits easily into a briefcase or battle dress uniform pocket. It is designed to be easily transported for use any time, anywhere. Readers should do just that. The booklet does not contain all the questions and answers that a project manager will face. However, those who know these 170 questions and understand the answers will know a lot. They will know more about themselves and will be better able to lead their projects to a successful conclusion.

FROM THE DIRECTOR ACQUISITION CAREER MANAGEMENT OFFICE

The new millennium is now upon us. We have survived Y2K and the holidays and now must set our sights on the new year. The Acquisition Career Management Office (ACMO) is focusing on a number of career management issues in 2000. As I mentioned in my last letter, we have been working with our counterparts at the U.S. Total Army Personnel Command (PERSCOM); the Army Acquisition Executive Support Agency (AAESA); and the U.S. Army Research, Development and Acquisition Information Systems Activity (RDAISA) to re-examine the roles and missions of each organization in supporting the Army Acquisition Corps (AAC).

As the AAC has grown, each organization has tried to fill the gaps in the absence of clearly defined organizational lines. We recognize the result has been a difficult maze for Acquisition Workforce members seeking help. Our re-examination of roles and missions is complete, and we recently introduced our ideas at the Acquisition Workshop in New Orleans. We will continue to spread the word in a new *Acquisition Playbook* that should soon be hitting the streets.

I want to thank PERSCOM Acquisition Management Branch Chief LTC Robert Reyenga, RDAISA Commander LTC Stephen Buck, and new AAESA Director Karen Walker for their support in working through the many issues impacting our organizations. Working together has been a great experience that will allow us to receive the most benefit from our expanding regional support structure.

The AAC is now in its 11th year following an exciting first decade. Be sure to read the article on the AAC's 10th anniversary celebration that begins on Page 55 of this magazine. I also want to direct your attention to the article on Acquisition Branch Qualification, the new career development concept being developed by the ACMO.

Army RD&A is just one of many sources for obtaining information related to your development as an acquisition professional. Watch for the winter issue of the *Army Acquisition Workforce Newsletter,* which will soon be in your mailbox. The newsletter is a great way to learn what other professionals in the Acquisition Workforce are doing. I encourage you to visit the AAC home page at **http://dacm.sarda.army.mil** for the latest information on acquisition career management.

By the time you read this, the Army Acquisition Workforce 2000 (AAW 2000) briefings will be well underway. Check the AAC home page for details about the next AAW 2000 briefing scheduled in your region.

Congratulations to the AAC members selected to attend the Senior Service College during academic years 2000 through 2001. Don't miss the articles in this issue on applying for Senior Service College and on the upcoming Lieutenant Colonel Promotion Boards.

One final note to our civilian workforce: we are truly in need of more quality applicants for our Product and Project Manager Boards. Our shrinking military officer population can no longer sustain the many programs required to support the Army's ambitious modernization plans. Our briefings this year will focus on who has succeeded and how you, too, can succeed in the "best qualified" boards. We know we have the qualified people and plan to aggressively solicit your participation in next year's boards. If you are interested, you can start now by working with your career manager to bring your acquisition management file up to date.

COL Roger Carter
Director
Acquisition Career Management Office

Acquisition Branch Qualification

The Acquisition Career Management Office (ACMO) is developing a new career development concept known as Acquisition Branch Qualification (ABQ). ABQ establishes a "branch-qualification" formula to help define the career-development process. Using the ABQ concept, Army Acquisition Workforce (AAW) professionals will soon be able to identify positions that will help them obtain the experience they need to become more competitive for assignment to critical acquisition positions (CAPs).

ABQ is an element of the integrated career model of the Acquisition Career Development Plan (ACDP). Performance in ABQ positions will more clearly communicate an individual's potential for selection to CAPs. For military personnel, CAPs are considered equivalent to battalion executive officer and S3 positions, and assignment to a CAP will enhance the officer's file for selection boards. For civilians, performance in CAPs will illustrate their key leadership and functional competencies, providing a more recognizable picture to selection boards and officials.

The framework for ABQ begins with position identification through the use of a template to profile all AAW positions. The ACMO, in coordination with the acquisition community, is developing a template that will identify positions meeting ABQ criteria. Generally, ABQ positions will be cross-functional and will require leadership competencies. Commands will use the template to develop position descriptions for submission to the Acquisition Position List (APL) Board. The APL Board will convene annually to validate positions designated as acquisition branch qualifying.

In the future, service in ABQ positions will be documented on Officer Record Briefs or Acquisition Career Record Briefs and on Officer Evaluation Reports, Total Army Personnel Evaluation System, or Contribution-Based Compensation and Appraisal System performance documents. To be acquisition-branch qualified, AAW members must complete an ABQ assignment and be Level III certified in a single acquisition career field (ACF), be Level I or II certified in an additional ACF, complete Military Education Level 4 or equivalent, attain minimum Army Acquisition Corps requirements, and complete a qualifying "Q" course (potentially the Materiel Acquisition Management Course).

Ultimately, selection boards and officials will be given guidance on the importance of ABQ positions in the selection process. However, guidance will not be given to boards until the Director, Acquisition Career Management is sure that all AAW members have had a reasonable opportunity to serve in ABQ positions.

The key leadership competencies being considered as part of the ABQ position template are taken from the Office of Personnel Management's five Senior Executive Service Executive Core Qualifications (ECQs), which can be found at **http://www.opm.gov/ses/html/ecq4.htm**. These ECQs are comprised of 27 leadership competencies designed to demonstrate experience and potential to succeed at the highest levels. The ACMO is working with Career Functional Representatives to also incorporate functional competencies as part of the ABQ concept.

In the future, the Acquisition Branch Qualification process will support the ACDP and be documented as part of the Individual Development Plan (IDP). The process will also ensure that AAW professionals acquire and demonstrate the essential skills and competencies necessary to serve in CAPs. The goal is to provide selection boards and officials a common picture of past performance and potential for CAPs for both military and civilians. Most important, the ABQ process enhances the ability of AAW members to take control of their careers by enabling them to identify positions that support their IDP.

FY00 Regional Acquisition Workshops Rescheduled

The first-quarter FY00 Regional Acquisition Workshop and Executive Session, originally scheduled for Nov. 3-4, 1999, and rescheduled for Dec. 2-3, 1999, has been rescheduled again and combined with the second-quarter FY00 Regional Acquisition Workshop and Executive Session.

The combined first- and second-quarter FY00 Regional Workshop and Executive Session will be held at the Army Developmental Test Command (formerly the U.S. Army Test and Evaluation Command), Aberdeen Proving Ground, MD. It will be held Feb. 8-9, 2000. Invitees will include Army acquisition leaders, program executive officers, deputies for systems acquisition, and product and project managers (PMs) from the following:

- PEO, Information Systems;
- PEO, Standard Army Management Information Systems;
- U.S. Army Special Operations Command;
- U.S. Army Soldier and Biological Chemical Command;
- PEO, Intelligence, Electronic Warfare and Sensors;
- PEO, Command, Control and Communications Systems; and
- U.S. Army Communications-Electronics Command.

Others expected to attend are PMs reporting directly to the Army Acquisition Executive, National Capital Region (NCR) and Northeast Acquisition Commanders, and all other Army PMs in the NCR and Northeast Region.

Larry Williams, Headquarters, U.S. Army Materiel Command (HQ AMC), is the action officer for this session. He can be reached at (703) 617-4969 or DSN 767-4969.

The third-quarter FY00 Regional Workshop and Executive Session, and the Annual Acquisition Workshop and Executive Session will remain as originally scheduled. However, the locations of these workshops are being reconsidered. The third-quarter FY00 Regional Workshop will be held May 17-18, 2000, and will be coordinated by HQ AMC. The Annual Workshop will be coordinated by the Army Acquisition Executive Support Agency's Force Structures Division and held Aug. 22-24, 2000.

Army Acquisition Certification Policy And Procedures

Department of the Army Policy on Acquisition Career Field Certification has been revised. The new policy was approved on Sept. 30, 1999. A copy of the new policy can be obtained by clicking on the **Policy** section and then **Certification Policy** on the Army Acquisition Corps home page at **http://dacm.sarda.army.mil**.

The policy's new process removes the certification responsibility from the organization and places it within the acquisition career field. Certifying officials who have been selected by the functional chief representative for each career field will approve acquisition certifications. Officials are Level III certified in the career field in which they will be certifying other individuals. A list of the certifying officials, their locations, and their contact information is posted on the Army Acquisition Corps home page.

Two Important Documents Released To The Army Acquisition Corps

The Office of the Director for Acquisition Policy in the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (OASAALT) recently published two important documents. The first, DA Pamphlet 70-3, *Army Acquisition Procedures*, is a compilation of "how-to" information for the Acquisition Workforce. Examples of topics covered include type classification, Army Systems Acquisition Review Council procedures, test and evaluation, and Acquisition Corps career management. The pamphlet's format follows DOD 5000.2-R for easy cross-reference between Secretary of Defense and Army-level acquisition information. DA Pam 70-3 also has the distinction of being one of the first Army-level pamphlets that is available exclusively in electronic form. Two Internet sites provide links to Adobe Acrobat pamphlet files: the U.S. Army Publishing Agency site at **http://www.usapa.army.mil/gils/epubs12.html** and the OASAALT home page at **http://www.sarda.army.mil/library.htm**. The pamphlet will also be part of the next release of the *Defense Acquisition Deskbook*.

The second document, the *FY99 Acquisition Category Listing*, provides information on 572 Army acquisition programs. This Army Acquisition Category (ACAT) list expands on FY98's list by including the name of each program's Milestone Decision Authority (MDA), the grade category of each program manager (e.g., program manager, product manager, or system integrator), and the name of the program manager's organization. The FY99 ACAT list can be viewed via the OASAALT home page at **http://www.sarda.army.mil/index.htm**. The Web site provides several different database sorts of the information (e.g., by program title, by ACAT, and by MDA).

Recommended changes or additions to either DA Pam 70-3 or the FY99 ACAT list should be submitted to the Director for Acquisition Policy, SAAL-RP, OASAALT, 2511 Jefferson Davis Highway, Arlington, VA 22202-3911. Feedback can also be e-mailed to **Acq.Policy@sarda.army.mil**.

Systems Automation Engineering And Acquisition/Communications And Computer Conference

In February 2000, the Acquisition Career Management Office will host the first annual conference for Army Acquisition Corps (AAC) officers in the 51R area of concentration (Systems Automation Engineering and Acquisition—formerly known as Functional Area 53) and civilian AAC members in the Communications and Computer Systems acquisition career field.

For more information, contact LTC Greta Lehman at **lehmang@sarda.army.mil**.

AETE Board

The Acquisition Education, Training and Experience (AETE) Board meets biannually in January and June. The application suspense dates for upcoming boards are found under **News** on the Army Acquisition Corps (AAC) home page at **http://dacm.sarda.army.mil**.

The recently updated *AETE Catalog* contains numerous education, training, and experience opportunities available to AAC members. This catalog can be found on the AAC's home page at **http://dacm.sarda.army.mil/careerdevelopment**.

The process for submitting applications to the AETE Board for these learning opportunities is located under the **Application Instructions** section of the catalog (click on **Acq. Edu., Training & Exp. Board**).

AAC Celebrates 10th Anniversary!

Celebrations marking the 10th Anniversary of the U.S. Army Acquisition Corps (AAC) began Oct. 10, 1999, and continued during the week of the 1999 Association of the United States Army (AUSA) Annual Meeting. A series of special events commemorated this important milestone, including AAC team participation in the annual Army Ten-Miler, an AAC anniversary exhibit and a career-counseling suite staffed by career development experts from the Acquisition Career Management Office (ACMO) at AUSA, and a special showing of the anniversary exhibit at the Pentagon. The culmination of the week's festivities was the AAC's 10th Anniversary Commemoration Ball.

The anniversary kickoff began on a rainy morning with four AAC teams running in the annual Army Ten-Miler. The day ended with the first annual AAC Ball, at which weary, but exhilarated, AAC team members were recognized for their outstanding efforts by LTG Paul J. Kern, Director for Acquisition Career Management (DACM).

The Ball, held in Arlington, VA, was a smashing success. More than 300 members of the acquisition community as well as senior acquisition leaders joined other attendees to celebrate a decade of success. All enjoyed dining, dancing, toasts, and music in an environment of good company. Paul J. Hoeper, Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASAALT) and the Army Acquisition Executive (AAE), hosted the festive, black-tie dinner dance. Kern and Deputy DACM Keith Charles served as Masters of Ceremonies.

After opening toasts and guest introductions, dinner was served while the U.S. Army Chorus provided a fabulous show that included pop and Broadway music as well as traditional military and patriotic selections.

Following the chorus' serenade to the AAC, Charles began the evening's formal celebration with remarks saluting the AAC. "We have the best Acquisition Corps," he said, and further reflected on how difficult it is to believe that 10 years have passed since inception of the Corps. Charles stressed the importance of looking at the AAC's past successes to help focus on best meeting the Army's acquisition needs now and in the future.

Charles concluded his remarks with the introduction of the new AAC video presentation, *Lock, Stock and Barrel*, a documentary created for the 10th anniversary commemoration, heralding past contributions of the Army Acquisition Workforce. The video included archival photos, historical film clips, and interviews with historians and former acquisition leaders such as Norman Augustine, GEN Carl Vuono, GEN Gordon R. Sullivan, and LTG Ronald Hite.

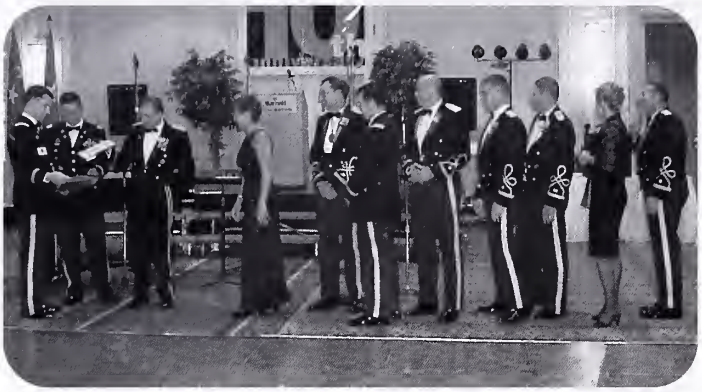
After the premiere of the video, guest speaker George G. Williams, U.S. Army Retired and now President of Collazo System Analysis Corp. (COLSA), borrowed a quote from famed baseball star Yogi Berra to begin his keynote address, saying, "The future ain't what it used to be!" Williams focused on the key role the AAC plays in contributing to the success of the warfighter and the importance of sustained growth. The AAC's challenge, he said, is to keep pace with the innovations taking place in this country to provide more meaningful support to the warfighters. Williams paid his highest compliment to AAC personnel by stating that given the choice, he would always fill positions within his organization with members of the AAC because of their superb qualifications.

Shown left to right are Mary Thomas, Deputy Director, ACMO; George G. Williams, President of COLSA Corp.; and DACM LTG Paul J. Kern.

Following Williams' speech, Kern presented a certificate of recognition to each runner that participated in the 15th Annual Army Ten-Miler. He asked that Williams' words be taken to heart regarding the challenge the Army faces in the future.

Concluding the formal portion of the AAC's 10th Year Anniversary Commemoration Ball, Hoeper said, "This is a great day to be in the Army Acquisition Corps!" He then thanked Kern, Williams, and Charles for making this historic evening possible and encouraged guests to enjoy the remainder of the evening.

Although the Ball was scheduled to end at midnight, this truly fitting conclusion to the AAC 10th Anniversary celebration saw many AAC members dancing well into



DACM LTG Paul J. Kern (third from left) presents awards to members of the AAC Army Ten-Miler team present at the AAC 10th Anniversary Ball.

the night. It was evident that each attendee took personal pride in their accomplishments and dedication, which have contributed to making the AAC a shining example of an organization that provides soldiers with systems critical to decisive victory now and into the 21st century.

On Monday, Oct. 11, 1999, the AAC 10th Anniversary exhibit was put on display at AUSA's Annual Meeting following the opening ceremony hosted by Secretary of the Army Louis Caldera.

During the 3 days of the AUSA meeting, Oct. 11-13, 1999, numerous visitors viewed the AAC's "We're With You" anniversary exhibit. In addition, for the first time at AUSA's Annual Meeting, the ACMO provided career development guidance and counseling in a suite adjacent to the exhibit. Highlighting key systems and events in acquisition history, the exhibit featured the video *Lock, Stock and Barrel* and provided an opportunity to share information about the AAC with many members of the Army community. At the conclusion of the AUSA Annual Meeting, the AAC exhibit was displayed at the Pentagon Oct. 12-22, 1999.

PERSCOM Notes . . .

Army Acquisition Officers Change To One Functional Area

To align the Army Acquisition Corps within the Officer Personnel Management System XXI (OPMS XXI) structure, all acquisition officers in functional areas (FAs) 51, 53, and 97 have been combined into a single FA 51. In addition, captains, majors, and lieutenant colonels are designated with an area of concentration (AOC) based on their former FA. Shown below is a list of old and new designations.

Old FA	New FA/AOC
51	51S (Research and Engineering)
53	51R (Automation Systems Acquisition)
97	51C (Contract and Industrial Management)

Colonels have been given a new FA/AOC of 51Z.

The new FA51 and designated AOCs were updated in the PERSCOM database on Oct. 25, 1999. Officers will see the changes in their officer record briefs printed after this date.

The change to a single FA51 with multiple AOCs is the beginning of new career paths specified in Department of the Army Pamphlet 600-3, *Commissioned Officer Development and Career Management*. **The intent is for all officers to become Level III certified in a primary AOC and Level II certified in a secondary AOC.**

A result of these changes will be the assignment of officers across AOCs. For example, an FA51 officer with a primary AOC of "S" may be assigned to a Military Acquisition Position List (MAPL) position requiring a "C" area of concentration. This change will allow acquisition officers the opportunity to work in positions previously not available to them.

PERSCOM's Acquisition Management Branch (AMB) also plans to realign internal officer management functions as the current assignment officers rotate out of PERSCOM during the summer of 2000. For current information on these changes, check the AMB home page at: **http://www.perscom.army.mil/OPfam51/amb_main.htm**.

Officer Senior Service College Results Released

Results of the Senior Service College (SSC) Selection Board were released Oct. 26, 1999. The following 29 Army Acquisition Corps (AAC) members were selected to attend SSC during academic year 2000-01:

Academic Year 2000-01 Senior Service College Selectees

LTC STEPHEN G. BIANCO
LTC JOHN D. BURKE
LTC ALFRED A. COPPOLA
LTC WILLIAM T. CROSBY
LTC RICHARD P. DEFATTA
LTC GENARO J. DELLAROCCO
LTC KEVIN M. DIETRICK
LTC EDMUND A. DOWLING
LTC WILLIAM T. DRUMMOND
LTC CLOVIS G. GAULT
LTC JACOB N. HAYNES
LTC KURT M. HEINE
LTC THOMAS H. HOGAN
LTC SHARON L. HOLMES
LTC RUSSELL J. HRDY
LTC STEPHEN D. KREIDER
LTC WILLIAM G. LAKE
LTC CURTIS L. MCCOY
LTC EDWARD D. MCCOY
LTC PAUL M. MCQUAIN
LTC LEONARD R. MONTFORD
LTC RALPH G. PALLOTTA
LTC CHRISTOPHER PARKER
LTC KENNITH POLCZYNSKI
LTC BRYAN R. SAMSON
LTC MICHAEL SMITH
LTC MICHAEL J. SMITH
LTC MARK M. VAUGHN
LTC JAMES E. WEGER

The AAC had a total of 397 officers eligible for selection to SSC and had a selection rate of 7.5 percent. The Army selection rate was 7.4 percent.

The following chart represents the year groups and functional areas of the officers selected:

YEAR GROUP	FA51	FA53	FA97
1978	6	1	1
1979	6	2	3
1980	3	1	2
1981	3	1	0
	18	5	6

The most common factor for each of the officers selected for attendance at SSC is that each was a former command selection list (CSL) selectee for product manager or acquisition commander or a current product manager or acquisition commander. This confirms what the U.S. Total Army Personnel Command has stated previously: the path to SSC selection includes a successful CSL product manager or acquisition command tour.

Each officer selected for attendance at SSC was provided with a CD-ROM containing instructions for submitting preferences for attending SSC or a fellowship program.

Upcoming Boards

FY00 Lieutenant Colonel Promotion Selection Board

The FY00 Lieutenant Colonel Promotion Board will convene Feb. 29-March 31, 2000. Look for a Department of the Army message officially announcing the board. Promotion eligibility is based on your date of rank to major. The tentative zones of consideration for this board are listed below:

Above Zone:	May 1, 1995, and earlier
Primary Zone:	from May 2, 1995, to March 1, 1996
Below Zone:	from March 2, 1996, to Jan. 1, 1998

Army Officer Senior Service College Board Date Announced

A Department of the Army (DA) selection board will convene April 4-28, 2000, to consider eligible lieutenant colonels and promotable majors for selection to attend the Army Senior Service College. Promotable majors must have their lieutenant colonel rank pinned on before the board convenes. If this applies to you, carefully review the upcoming DA message announcing the board.

Many officers have inquired about their chances of getting selected. The answer is very speculative because past trends show that at least one and usually two O-5 command officer evaluation reports (OERs) are necessary to be "in the running." This is not a specific requirement, but is in keeping with previous board results.

Eligible officers are also encouraged to complete the Command and General Staff College correspondence course if they are not already a graduate. Additional guidance on preparing for the board follows.

Selection Board Announcements

Department of the Army (DA) selection boards are announced by individual DA messages. A list of FY00 Army officer selection board dates is available at **http://www-perscom.army.mil/select/bdschd00.htm**. To access information regarding specific boards, go to the following Web address: **http://www.perscom.army.mil/tagd/msg/2000.htm**. The DA message announcing specific boards will provide the critical deadlines associated with zones of consideration, officer evaluation reports (OERs), and other documents that need to be forwarded to the U.S. Total Army Personnel Command (PERSCOM).

Preparing For Army Selection Boards

Here are some things that eligible officers can do to prepare themselves for selection boards:

• Verify all entries on your Officer Record Brief (ORB). The ORB is a quick "snapshot" of an officer and establishes the initial impression of your overall assignment history and your qualifications. Duty titles with unusual acronyms are a problem on ORBs, so use plain, understandable language. Remember, only one board member is in the Army Acquisition Corps. Ensure that your list of awards and badges is current. If there are any discrepancies, send a copy of your award certificate only (with the orders number and social security number written on it) directly to your assignment officer. There should be an academic evaluation report or ORB to account for all active federal commissioned service. ***Note:*** *When board ORBs are printed, absolutely no data from your program, education, other, or total time for acquisition certification are shown. Certification is not a criterion for selection.*

• Contact your local personnel service center (PSC) or military personnel office (MILPO) to update your e-mail address, home address, and duty and home phone numbers. This information is not part of the board ORB, but it must be current in PERSCOM's automated personnel network. Assignment officers need some way to contact you if there are problems or questions regarding your board file. If your PSC or MILPO is unable to make these changes, contact the appropriate assignment officer listed in the last paragraph of this article.

• Update your photo. New photos are required every 5 years; however, a new digital/computerized color image is strongly recommended. Also, your photo should match the information in your ORB (rank, awards, badges, etc.). Be sure your basic branch (not Acquisition Corps) is shown on the photo in the personal data. In general, board members view an updated photo as initiative from officers who care about their files. Send two copies of your photo to your assignment officer in PERSCOM's Acquisition Management Branch (AMB). Do not allow the photographer to send in your photo. The AMB mailing address is U.S. Total Army Personnel Command, ATTN: TAPC-OPB-E (Assignment Officer's Name), 200 Stovall Street, Alexandria, VA 22332-0411.

• Review your microfiche and tell us what is missing. There should be a set of orders on your fiche for every award and badge in your ORB (except those issued without orders, such as the Army Service Ribbon or Overseas Service Ribbon). OERs and academic evaluation reports should account for all military service time. Meritorious Service Medals and higher awards are critical. Ensure that all qualification badges (ranger, airborne, etc.) are also documented. Procedures for requesting a copy of your microfiche can be accessed at **http://www.perscom.army.mil/opod/fiche.htm**.

• Ensure your closeout and/or annual OER is submitted on time. The DA message announcing the board will specify the "through" date for closeout OERs and a "received-no-later-than" date. Many senior raters hold OERs until the last minute, and some OERs have arrived dangerously close to the cut-off date. Assignment officers are not part of the OER processing procedures. Your PSC or MILPO sends OERs directly to the OER Branch at PERSCOM. You can determine if your OER was received by the OER Branch by sending a message to: **tapcmser@hoffman.army.mil**.

If you have any questions, contact the following assignment officers:

FA51 (51S) (MAJ): MAJ Brian Winters, (703) 325-3128, DSN 221-3128
e-mail: **wintersb@hoffman.army.mil**

FA51 (51S) (LTC): MAJ John Masterson, (703) 325-3129, DSN 221-3129
e-mail: **mastersj@hoffman.army.mil**

FA97 (51C) (MAJ/LTC): MAJ Jay Norris, (703) 325-5479, DSN 221-5479
e-mail: **norrisj@hoffman.army.mil**

FA53 (51R) (MAJ/LTC): MAJ Steve Decato, (703) 325-3124, DSN 221-3124
e-mail: **decatos@hoffman.army.mil**

FY99 Major Promotion Board Results

FY99 Major Promotion Board results were released Oct. 7, 1999. The Army Acquisition Corps (AAC) selection rate was above the Army average for promotion to major. Following is an analysis of the board results.

Overall Acquisition Corps Results

Board members reviewed the files of 121 AAC officers in the primary zone. From this population, the board selected 96. The resulting primary zone selection rate of 80.1 percent was above the Army competitive category primary zone of 78.1 percent. In addition, three officers below the zone and one officer above the zone were selected for promotion. AAC results by functional area follow:

Functional Area	Primary Zone Considered	Primary Zone Selected	Primary Zone Percent
51(51S)	55	46	83.6%
53(51R)	25	18	72.0%
97(51C)	40	32	80.0%

What Was The Trend For Those Selected?

After the assignment officers re-examined the files of all AAC officers considered for promotion to major, the following trend or "formula" emerged:

MAJ = Above Center of Mass (ACOM) Command + COM (+) File (Overall)

Selection to major is a reflection of how an officer performed in his or her basic branch assignments. Most AAC officers have few, if any, officer evaluation reports (OERs) from acquisition assignments when they are considered by the Major Promotion Board. Many officers are still completing basic branch assignments, Reserve Officer Training Corps/recruiting, Active Component or Reserve Component assignments, or attending advanced civil schooling. Thus, AAC officers are judged against the same criteria as basic branch officers.

The Army is more competitive now than ever before. There were minimal differences between the files of year group (YG) 1988 (officers in last year's primary zone) and YG89 (officers in this year's primary zone). The continued upward trend in OER ratings was readily apparent with the close-out report as the Officer Personnel Management System XXI's (OPMS XXI's) new OER was implemented. Second lieutenant OERs were not reviewed by the promotion board and were removed from the officer's file. All OERs became critical in determining the overall trend in performance and evaluation potential.

The most important discriminator continues to be company command OERs. Board members appear to use command reports as the measure of an officer's ability to succeed as a major. With a majority of the officers receiving "one"-block command OERs, the words written by the senior rater played an important role in determining if an OER was truly top block. Because there were many top-block-heavy senior-rater profiles, board members were often required to determine if a top block OER was above center of mass or center of mass.

Senior-rater narratives that quantified an officer's performance when the profile did not, provided a clearer picture to the board on the "true block check" (i.e., best officer in a command, top 1 percent, 1 out of 10). Additionally, senior-rater narratives that focused on the potential of the officer were more critical in determining a true top-block-command OER than OERs that focused on how the officer performed in the job. Officers with above-center-of-mass files and "two"-block center-of-mass command OERs were not selected for promotion. Officers with center-of-mass files and top-block center-of-mass command OERs were at risk for promotion.

Performance in basic branch assignments, especially company command, appeared to be the board's focus. The message is clear: seek company command, do well, and maintain a high level of performance on all other assignments. The FY99 Major Promotion Board selectees are as follows:

MAJOR PROMOTION LIST

ABRAMSON ALFRED	51S
ARCHAMBAULT BRUCE	51S
ARDREY EDWARD	51R
ARMSTRONG SCOTT	51S
ASCURA MICHAEL	51S
BARBER CREIGHTON	51R
BERG DAVID	51R
BHE JEFFREY	51R
BORJES KARL	51C
BRICE WILLIS	51C
BRIGHAM DAVID	51C
BROWN AARON	51S
BROWN CHRISTOPHER	51S
BUHL HAROLD	51S
BUSH MICHAEL	51S
CARR JAY	51C
CLADY JOHN	51C
CLARK WILLIAM	51C
COMPTON RAYMOND	51R
COOPER JEFFREY	51C
COX BRIAN	51S
CURTIS TODD	51R
DAVIS GERALD	51S
DEAKINS THOMAS	51C
DELANEY JAMES	51S
DIONISIO ROBERT	51R
DONOVAN SHARLENE	51S
DUNLAP ERNEST	51R
DUPONT JOSEPH	51S
EMERSON CHARLES	51S
EPPS WAYNE	51C
FRANKS GREGORY	51C

GEDULDIG TERESA	51S
GRESHAM SHAWN	51R
HAINES ALLEN	51S
HALE TIMOTHY	51S
HARRISON JOHN	51S
HANNON TIMOTHY	51C
HILL RONALD	51C
HOLLAND GEORGE	51C
HOMAN LARRY	51R
HOWARD TERRENCE	51R
JACKSON TONIE	51C
JACOCKSCRIEVECOEUR JACQUELIN	51S
JERNIGAN LAFONDA	51C
JOLLY EDWARD	51S
JONES JAMES	51S
JONES MICHEL	51S
KACZMARSKI DAVID	51C
KEMMERER DAVID	51C
KETCHUM ROBERT	51S
KISER DOUGLAS	51C
LAMB TODD	51S
LANGWINSKI EDWARD	51C
LEATH DONALD	51C
LEONARD KEVIN	51R
LIPPERT THOMAS	51C
LONG JONATHAN	51C
LOZIS PETER	51S
LUKER MARK	51S
MANZO JENNIFER	51C
MATLOCK JOHN	51S
MATTHEWS JOHN	51S
MILTON STEPHEN	51S
MYERS YVETTA	51S
NASSAR MICHELLE	51R
OYLER DOUGLAS	51S
PARDEW PAUL	51C
PERRY CHRISTOPHER	51C
PICKERING RAYMOND	51S
PIERCE STEVEN	51R
PILGRIM ALLEN	51S
RAUER SCOTT	51S
RICKEY JON	51S
ROBBINS JASON	51S
ROBINSON KELVIN	51C
ROBINSON WILLIE	51R
ROGERS STEPHEN	51S
SCHUETZ DOUGLAS	51C
SIMPKISS KENNETH	51S
SOSINSKI MARGARET	51R
SPENGLER WILLIAM	51S
STOVER HOWARD	51C
SWEETSER NATHAN	51R
THOMAS BRENT	51S
THOMAS TODD	51C
THOMPSON BRIAN	51S
THURSTON MICHAEL	51R
TODD THOMAS	51C
TULL PHILIP	51S
VOGELHUT JONAS	51S
WALTERS KAREN	51S
WEGLER MICHAEL	51C
WILLIAMS RICHARD	51S
WILLIAMS RODNEY	51C
WRIGHT GARY	51C
YATES EMMETT	51C
ZRIMM MICHAEL	51S
ZYBURA MARTIN	51C

The Career Field Designation Board also accessed the following 36 promotable YG89 captains into the AAC:

BAILEY WILLIAM
BROWN ANTONIO
BRYANT TONYA
CHOUNG JAMES
CONWAY JOHN
CRUMLEY DENNIS
DANNER DAVID
DEASE CHARLES
DUTCHIE ROBERT
FLOERSHEIM ROBERT
GRAHAM GORDON
GRAUEL DAVID
HADDON COIL
HANSEN DIANA
HEDEEN ALBERT
JAMISON VERNON
KIZZIE COYEA
LUCAS ALEX
MALONE VINCENT
MCDERMOTT BROWN
MILLER THEODORE
NELSON SCOTT
NEWELL MICHAEL
OCONNELL DAVID
PEEL KEVIN
RAMSEY PRISCILLA
ROBERTSON KENNETH
SCOTT LANCE
STEINHOLTZ LINDA
STINE JASON
STONE MARK
VANNOLEJASZ SANDRA
WALLACE GORDON
WITHERS JOHN
WOODS JEFFREY
WYGAL WILLIAM

New Computer Display Gives Troops Tactical Edge

A new computer display being developed by the U.S. Army Soldier and Biological Chemical Command's (SBCCOM's) Soldier Systems Center (Natick), the Defense Advanced Research Projects Agency (DARPA), and two contractors, Honeywell Inc. and Kent Displays Inc., could dramatically enhance the capabilities of field soldiers.

Known as the Miltary E-Book, the computer display acts as a document viewer and terminal that receives data and graphics. The display, which can interface with a body-worn computer, will give soldiers the ability to perform computational operations, store data, and communicate quickly with one another. Additionally, they will be able to view maps, orders, and troop movements.

An image can remain indefinitely once it has been loaded into the ultra low-power, wireless, interactive document viewer—even after power has been removed. Additionally, because the product is lightweight and small (about 5 by 7 inches), it will not significantly increase a soldier's load.

According to Henry Girolamo, Natick Program Manager and DARPA Agent, the display can be carried on the belt, in a cargo pocket, or on load-bearing equipment. The display will be part of a wearable computer system being developed by DARPA.

The document viewer is visible in bright sunlight. However, because it produces no light emissions at night, it does not pose a threat to soldier security and safety. Soldiers will wear special goggles to read the display at night.

According to Girolamo, the zero-power document viewer will be a valuable soldier-system peripheral that will allow warfighters to wirelessly share alphanumeric and graphical data through their wearable command, control, communications, computers, and intelligence systems. Additionally, light management will be possible during night operations because there is no emission of light.

The document viewer will first be tested by U.S. Army Military Police. The Army's Special Operations Forces have also expressed interest. The document viewer will also prove useful to Air Force pilots, who will use it to access maps and orders and communicate with others.

Additional capabilities may be added in the future, including the ability to display pages from a memory card, which would make the viewer autonomous.

For more information about the Military E-Book, SBCCOM, or the Soldier Systems Center, please visit the Web site at **http://www.sbccom.army.mil**.

ARL Engineer Honored For SIDS Sensor

Late last year, Michael Scanlon, an engineer at the Army Research Laboratory (ARL), Adelphi, MD, received the Electrotechnology Transfer Award at the Institute of Electrical and Electronics Engineers' Engineering in Medicine and Biology Conference in Atlanta, GA. The award honors government and nongovernment employees whose achievements in advanced electrotechnologies were successfully transferred to the commercial sector.

Scanlon, who works in ARL's Sensors and Electron Devices Directorate, invented an acoustical sensor pad useful in monitoring Sudden Infant Death Syndrome (SIDS). SIDS affects infants who stop breathing and die for no apparent reason. Along with the Army, Scanlon co-holds three patents on this sensor.

The acoustic sensor pad is a fluid-filled bladder with a hydrophone that couples to the torso. Because the human body is mostly water, the pad acts as a fluid extension of the body to form an acoustical conduit to the hydrophone within the pad that detects body sounds. Heartbeats, breathing, motion, and other physiological sounds can be detected, transmitted, and monitored or analyzed for diagnostic purposes. The pad can be either hand-sized or full torso. It also has potential applications for medical diagnosis, patient care, and research.

Two companies have signed patent licensing agreements with ARL to develop the sensors for commercial applications. One company plans to develop the sensor to monitor SIDS and sleep apnea, a condition in which affected people stop breathing for varying periods of time while asleep. The other company will develop the sensor for use as a wrist-mounted monitor measuring a user's heart and breathing rates, blood pressure, and other physiological readings.

Scanlon is now working in an Army program to develop the sensor to be worn by soldiers to measure their vital signs in combat or during training.

Army RD&A Magazine Renamed

Effective with the March-April 2000 issue, *Army RD&A* magazine will be renamed *Army AL&T*. *AL&T* denotes acquisition, logistics, and technology and more closely reflects the missions and functions of the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology. This change complements the theme of the March-April issue—the Army Chief of Staff's vision for "Transforming the Force."

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- Overarching Partnering Agreements
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- The March Toward The Future Warrior
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